

26.

Eastern Pacific Expeditions of the New York
Zoological Society. XXVIII.

Fishes from the Tropical Eastern Pacific.

[From Cedros Island, Lower California, South to the Galápagos
Islands and Northern Peru.]Part 3. Rays, Mantas and Chimaeras.¹

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&

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(Plates I-IV, Text-figs. 1-40).

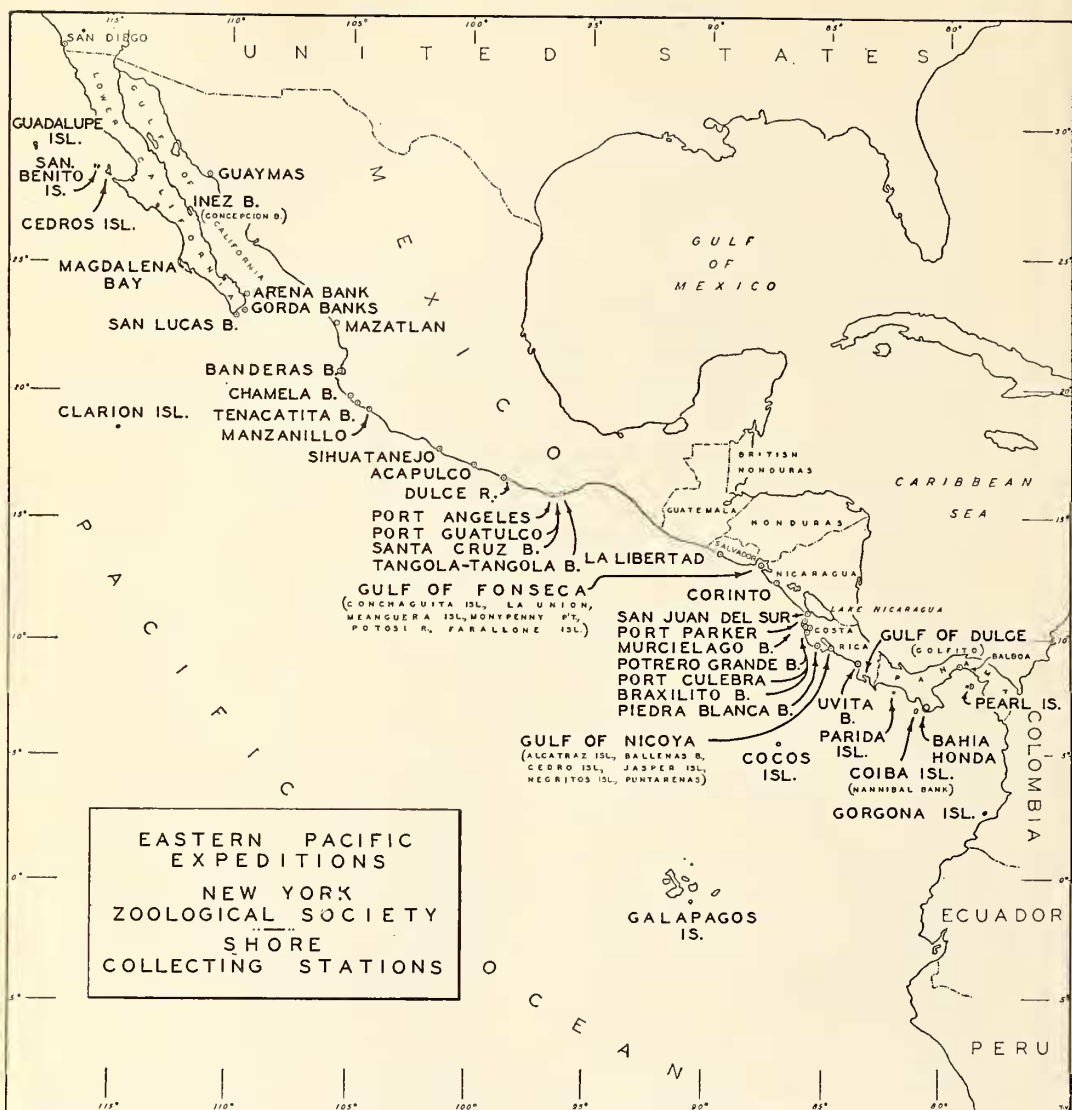
[This is the 28th of a series of papers dealing with the collections of the Eastern Pacific Expeditions of the New York Zoological Society made under the direction of Dr. William Beebe. The present paper is concerned with specimens taken on the *Noma* Expedition (1923), the *Arcturus* Oceanographic Expedition (1925), the *Antares* Expedition (1933), the Templeton Crocker Expedition (1936), and the Eastern Pacific *Zaca* Expedition (1937-1938). For data on localities, dates, dredges, nets, etc., of the second, fourth and fifth of these expeditions, refer to *Zoologica*, Vol. VIII, No. 1: 1-45 (*Arcturus*), *Zoologica*, Vol. XXII: 33-46 (Templeton Crocker), and *Zoologica*, Vol. XXIII: 278-298 (Eastern Pacific *Zaca*).]

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¹ Contribution No. 630, Department of Tropical Research, New York Zoological Society.

Part 1, Lancelets and Hag-fishes, was published in *Zoologica*, Vol. XXVI, pp. 89-92; Part 2, Sharks, in *Zoologica*, Vol. XXVI, pp. 93-122.



Text-figure 1.

Principal localities in the tropical eastern Pacific where collections were made by the Department of Tropical Research of the New York Zoological Society.

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INTRODUCTION.

This paper deals with rays and mantas collected in tropical eastern Pacific waters on five expeditions of the Department of Tropical Research of the New York Zoological Society under the direction of Dr. William Beebe. As an aid to future students we have included references to all species recorded from the tropical eastern Pacific.

The geographical boundaries of the region under consideration in this paper, and which we call the "tropical eastern Pacific," are as follows: The coastal waters of North and South America from Cedros Island, off the coast of Lower California, and the Gulf of California, southward to northern Peru, including off-shore islands such as the Galápagos and Revillagigedo groups, Clipperton, Cocos and Malpelo Islands.

As far as references are concerned, we have listed the original reference with type locality, and references referring to the region under discussion. Additional references have been added, however, whenever their inclusion was felt necessary. Some of the more commonly

cited papers have been referred to by name and not by publication, serial and page numbers; the full references will be found on page 279. Synonyms of nominal forms described from the region are included, but not necessarily those from extra-limital localities.

Forty-three rays and two chimaeras are reported from the waters of the tropical eastern Pacific.

We are indebted to Miss Janet B. Wilson for inking the drawings.

KEY TO THE FAMILIES OF RAYS AND MANTAS OF THE TROPICAL EASTERN PACIFIC.

- 1. Snout long, slender and flat, armed with strong teeth laterally (sawfishes). *Pristidae*, p. 253
Snout not armed with teeth laterally 2
- 2. Tail comparatively thick, bearing two dorsal fins; with or without a well-developed caudal fin; no serrated caudal spine. 3
Tail slender, with one or no dorsal fins; bearing a filamentous caudal fin in the *Dasyatidae*, otherwise without a caudal fin. 5
- 3. Caudal fin well developed; ventral fins not notched on outer edge (do not mistake notch formed by clasper of males for a notched fin) 4
Caudal fin absent, or represented only by a slight fold of skin; ventral fins notched on outer edge (do not mistake the notch formed by the clasper of the male for a notched fin); skin rough with scattered spines
Rajidae, p. 254
- 4. Skin rough with scattered spines; electrical organs not developed. *Rhinobatidae*, p. 250
Skin everywhere perfectly smooth; electrical organs developed. *Torpedinidae*, p. 247
- 5. Dorsal fins absent; eyes not at edge of head
Dasyatidae, p. 260
A single dorsal fin present; eyes at edge of head 6
- 6. Head with a pair of horn-like arms projecting forward. *Mobulidae*, p. 273
No horn-like arms projecting forward. 7
- 7. Snout bilobed. *Rhinopteridae*, p. 273
Snout single lobed. *Aetobatidae*, p. 271

FAMILY TORPEDINIDAE.

Key to tropical eastern Pacific genera.

- 1a. Pelvic fins distinct from body posteriorly, not joined together to form a disk. *Narcine*.
- 1b. Pelvic fins united to body along their entire length, joined together to form a disk
Discopyge.

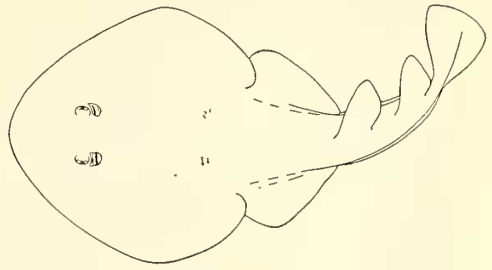
Narcine Henle, 1834.

Key to tropical eastern Pacific species.

- 1a. Disk with a single large ocellus in the center.
ommata.
- 1b. No ocellus in center of disk.
 - 2a. Disk with a few inconspicuous rings in the young, becoming uniform in color in the adult. *entemedor*.
 - 2b. Disk with numerous white vermiculations.
vermiculatus.

Narcine entemedor Jordan & Starks.

Ocellated Electric Ray.



Text-figure 2.

Range: Gulf of California to Panama (Mexico: San Felipe Bay, Gonzaga Bay, San Francisquito Bay, Mulege, Ballenas Bay, Carmen Island, Agua Verde Bay and La Paz, all in the Gulf of California, Mazatlan; Costa Rica: Gulf of Nicoya; Panama: Panama Bay).

Field Characters: Tail thick with two dorsals and a caudal fin well developed; pelvics not notched on outer edge; skin smooth everywhere. The ray is provided with electric organs which generate sufficient power for adequate protection. Pelvic fins separate. Young with several faint ocelli, disappearing in adult. (Illustration from Specimen 24,996; 385 mm.)

Color: The adult is uniform putty brown with indistinct spots of dusky on the body, both dorsals and caudal fin. In young individuals there are about four pairs of large ocelli on the upper surface, dark-centered with a pale outer ring of yellowish-tan. These markings fade with age so that in some specimens they are almost or quite absent.

Size: The largest recorded specimen is 762 mm. in length.

Local Distribution: We took this species only in Inez Bay, on the west coast of the Gulf of California. In mid-April they were found in shallow water at night.

Abundance: Records in literature are of single specimens, except at La Paz where they were said to be common. We found them abundant at night in Inez Bay.

Food: Specimen No. 25,249 had in its stomach a pure culture of red polychaete worms, armed with strong spicules. No. 24,996 had eaten six polychaete worms and one ascidian.

Study Material: 13 specimens. Mexico: Inez Bay; 12 rays seen, 6 collected (24,996, 25,235, 25,249); Photo. 7565; length 330 to 385 mm., April 13 to 16, 1936. Speared at night in shallow water in the southern part of Inez Bay.

References: *Narcine entemedor*, Jordan, D. S., Fishes of Sinaloa, 1895: 387, 508 (original description, color; type locality, Mazatlan, Mexico; La Paz). Gilbert, C. H., & Starks, E. C., Fishes of Panama Bay, 1904: 15, 207 (description, Gulf of California, Panama). Osburn, R. C., & Nichols, J. T., *Bull. Amer. Mus. Nat. Hist.*, 35,

1916: 144 (Mexico: Agua Verde Bay, Mulege). Meek, S. E., & Hildebrand, S. F., *Marine Fish of Panama*, 1, 1923: 74 (comparison with *Narcine brasiliensis*). Breder, C. M., Jr., *Bull. Bingham Oceanogr. Coll.*, 2 (1), 1928: 5, fig. 2 (Mexico: San Francisquito, Gonzago Bay, San Filipe Bay; Ballenas Bay on Carmen Island; color of young and adult, figure).

Narcine ommata Clark.

Range: Pacific Coast of Central America; exact locality unknown.

Field Characters: Tail thick with two dorsals and a caudal fin well developed; pelvics not notched on outer edge; skin smooth everywhere; electric organs present; pelvic fins separate; a brilliant ocellus in center of disk. Color markings strikingly similar to those of *Discopyge ommata* Jordan & Gilbert; but the species differs in not having the ventral fins united into a continuous disk as in *Discopyge*.

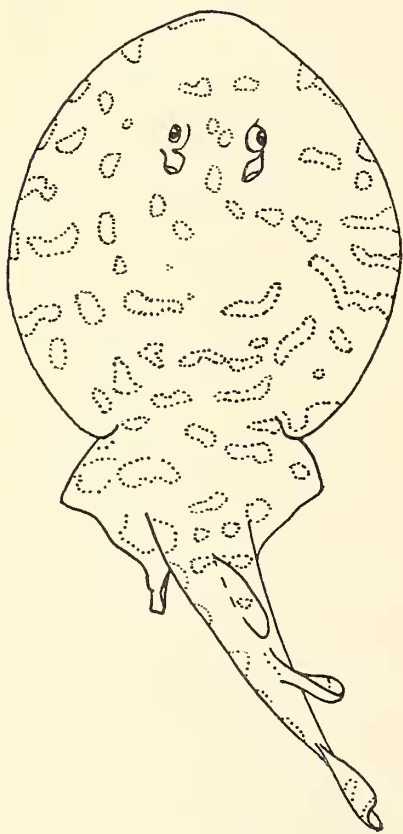
Study Material: None.

References: *Narcine ommata*, Clark, H. W., *Proc. Cal. Acad. Sci.*, 21, 1936: 383 (original description; type locality, Pacific coast of Central America, exact location unknown; type No. 5444, Mus. Cal. Acad. Sci., Ichthy.).

Narcine vermiculatus Breder.

Vermiculated Electric Ray.

(Plate I, Fig. 1).



Text-figure 3.

Range: Mexico, El Salvador. (Mexico: "west coast of Mexico," 15 miles west of San Benito, South Mexico, at 14° 40' 20" N. and 92° 40' 30" W.; El Salvador, off La Libertad, 13 fathoms.)

Field Characters: Tail thick, with two dorsals, caudal fin well developed; pelvics not notched on the outer edge; skin smooth everywhere; electric organs present; pelvic fins separate from each other; color as below. (Illustrations after Breder, 1928; 204 mm.).

Color: Deep chocolate brown above with numerous spots and vermiculations of white; ventral surface white except posterior edges of ventrals and pectorals which are slightly dusky; posterior edge of both dorsals and caudal edged with white; a single white spot a little longer than spiracle at the center of each dorsal; two irregular white bands across caudal; line bounding upper and lower coloration on peduncle, above dermal fold, wavy. In general the light marks tend to run transversely over body.

Size: Kumada records a two-foot specimen.

Study Material: 1 specimen, El Salvador: off La Libertad. Young male, (27,523), 58 mm., Dec. 16, 1937, dredged at station 198: D-1, 13 fathoms.

References: *Narcine vermiculatus*, Breder, C. M., Jr., *Bull. Bingham Oceanogr. Coll.*, 2 (1) 1928: 6, figs. 3 and 4 (original description; type locality, 14° 40' 20" N., and 92° 40' 30" W., 15 miles west of San Benito, South Mexico; type No. 1143, Bingham Oceanogr. Coll., Peabody Museum, Yale Univ.).

Narcine sp., Kumada T., & Hiyama, Y., *Marine Fish Pac. Coast Mexico*, 1937: 21, Plate 54, fig. B (short description, color, figure).

Discussion: Four specimens of this beautiful ray are now known, three of which are males. The nearest related species is *Narcine brasiliensis*, but differing from this, to mention only one of several characters, the Pacific ray has the pre-orbital snout in the disk length, 3 to 3.6 times, while in the Atlantic fish the proportion is 4.4 times. The variation in color and pattern in *brasiliensis* is extreme, and is apparently concerned with and influenced by locality, individuality and development.

This prepares us for acceptance of the corresponding but less extreme variation in the four known specimens of *vermiculatus*, as intraspecific.

In our 58 mm. ray the pattern is in the form of large, well-defined white spots on the body and central disk and pelvics, which become short, irregular bands on the disk margin, numbering 11 or 12 altogether. On the upper tail the white is in the form of 3 complete bands, and a 4th across the caudal fin. The 2nd and 3rd tail bands are enforced by a large spot on each dorsal. Both the dark color and several of the white bands overlap on the under side of the posterior half of both pectorals and pelvics.

The next ray in size is Breder's, which is three and a half times larger (204 mm.). Here the pattern deserves the specific name of *vermiculatus*, the white being reduced, and divided into small irregular spots and lines. In Kumada & Hiyama's plate of a ray of the same size (210

mm.), the pattern is again quite distinct. The white is still more reduced, and is faint, and in the form of a few meandering, irregular lines, most of which are on the outer margin of the disk and radiate outward. The tail bands are almost absent, but each unpaired fin still has a whitish line across it.

The 4th individual we know only from Kumada's brief mention of "other large specimen (2 feet)."

In both Breder's and our specimens the rims of the spiracles are smooth, and while Kumada & Hiyama mention "small tubercles" in their description, yet their plate, which is drawn in great detail, shows them smooth.

Discopyge Tschudi, 1846.

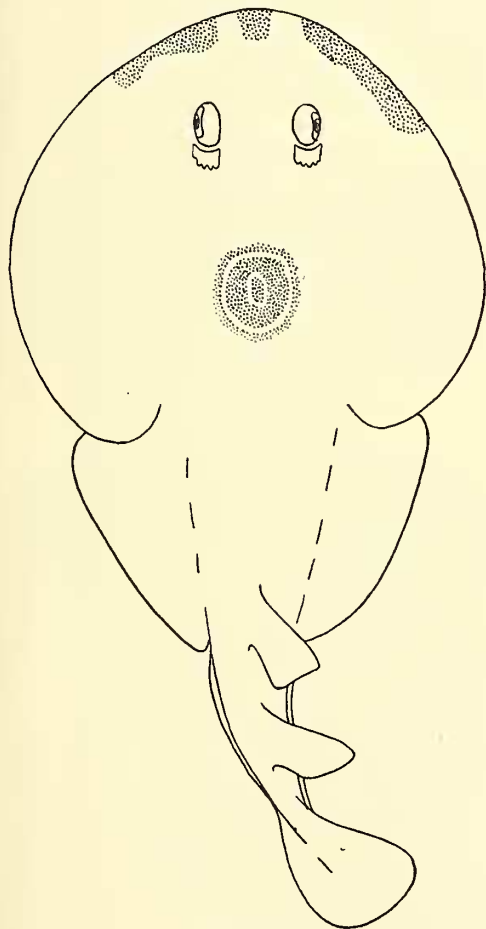
Key to tropical eastern Pacific species.

- 1a. A strongly marked, brilliant ocellus in the center of the disk *ommata*.
1b. No ocellus in center of the disk *tschudii*.

Discopyge ommata Jordan & Gilbert.

Ocellated Electric Ray.

(Plate I, Fig. 2).



Text-figure 4.

Range: Gulf of California to Panama (Mexico: Gonzaga Bay, Puerto Refugio, Inez Bay, Santa Cruz Island, San Francisco Island, Arena Point; Costa Rica: Port Culebra; Panama: 10 miles south of Pearl Islands, Bay of Panama).

Field Characters: Tail thick with two dorsals and a caudal fin; pelvics not notched on the outer edges; skin smooth everywhere. Provided with electric organs which generate sufficient power for adequate protection. Pelvic fins adnate to body. Color as below. (Illustration from specimen 25,236, 142 mm.)

Color: The color variations of six specimens are so extreme that no single description can cover all. This is not dependent on age, sex or locality and change of individual pattern can play but a slight part.

The commonest pattern is a light brown dorsal background, covered thickly with small, well-defined black dots. In the center of the back there is always a strongly-marked ocellus. This usually has a black or yellow ochre or rufous core, surrounded by a succession of solid or broken rings of alternating black and pale brown.

Other ocelli up to fourteen are scattered about on the upper surface, some like the spots of a jaguar, or again they may be almost solid. The most common situations are at the posterior inner angle of the pectorals, a pair close together between the central ocellus and the first dorsal fin, and one at the base of each dorsal fin. The preorbital area is free from dots and is marked with black and yellow ochre in the form of W's, M's and Y's. Below immaculate.

Our Arena specimens are wholly free from dots, the skin being faintly marbled, while the central ocellus has a small, bright rufous center, then a wide ring of black, outside of which is a narrow pale one. This concentration of pigment is evident in the post-pectoral and dorsal fin ocelli. There, extreme patterns are exhibited in specimens no more than 105 and 142 mm. apart in length.

A 65 mm. ray is thus described by Seale: "Mottled and marbled with brown over the back, with a distinct, round white spot surrounded by rings of black and white on the center of the back." Breder has found the same extremes of variation in specimens from the Gulf of California.

Size: The largest recorded specimen is our ray from Inez which measures 185 mm. in total length.

Local Distribution: These little rays have been taken not far from shore in 1 to 35 fathoms.

Abundance: Common at night in shallow water in Inez Bay. Elsewhere it has been recorded singly or in pairs.

Food: We found amphopods, small shrimps and worms in the stomachs. Also considerable quantities of very fine bits of quartz.

Breeding: In our largest specimen, a female of 185 mm. length, taken on April 10, the organs were considerably enlarged.

General Habits: At night, near shore, in the light of our flashes, these rays were clearly visible as they swam through mid-water or close to the bottom. Unharmred specimens, when picked up from the dredge hauls, gave forth an electric shock, especially if the fish was seized on each side of the ocellus, in the middle line of the body. The shock was sufficiently strong, if unanticipated, to make one drop the fish. It is said to generate as much as twenty volts. Three shocks in succession were noticed, the third weaker than the others.

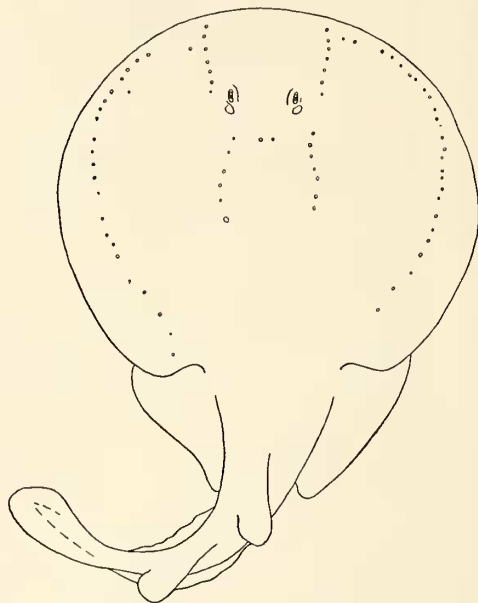
The conspicuousness of the pattern suggests the possibility of its serving a function of warning to vertebrate enemies.

Study Material: 11 specimens: Mexico: Inez Bay, 3 males, 2 females (25,774) 116 to 174 mm. April 13, 1936, speared at night in shallow water (one saved); Inez Bay, 1 male, 1 female (24,932) Col. Plate 31,168 and 185 mm. April 10, 1936, dredged, Station 141:D-1, in 7 to 9 fathoms; Inez Island, 1 male, (25,236) 142 mm. April 9, 1936, dredged in shallow water; Arena Bank, 1 male, 2 females (25,338) 105, 120, 155 mm. April 19, 1936, male dredged at Station 136:D-5 in 33 fathoms, females Station 136:D-6 in 35 fathoms.

References: *Discopyge ommata*, Jordan, D. S., & Gilbert, C. H., in Jordan, D. S. & Bollman, C. H., *Proc. U. S. Nat. Mus.*, 12, 1890: 151 (original description, color; type locality, 10 miles south of Pearl Islands, Bay of Panama). Jordan, D. S., & Evermann, B. W., *Fishes of North and Middle America*, 1896: 78 (short description). Osburn, R. C., & Nichols, J. T., *Bull. Amer. Mus. Nat. Hist.*, 35, 1916: 144 (Santa Cruz Island, Gulf of California). Meeke, S. E., & Hildebrand, S. F., *Marine Fishes of Panama*, 1923: 74 (short description). Breder, C. M., Jr., *Bull. Bingham Oceano. Coll.*, 2 (1), 1928: 8 (color variation, Gulf of California; Angel Island, Gonzago Bay, San Francisco Island). Beebe, W., *Bull. N. Y. Zool. Soc.*, 39, 1936: 236 (figure). Beebe, W., "Zaca Venture," 1938: 123, 300, fig. 10 (note on electric shocks, figure). Seale, A., *Allen Hancock, Pac. Exped.*, 9, 1940: 2 (color; Costa Rica: Port Culebra).

Size: The Peruvian specimen was 143 mm. in length. A male from the Atlantic measures 410 mm.

Study Material: None.



Text-figure 5.

References: *Discopyge tschudii*, Heckel, J. T., in Tschudi, J. J., *Fauna Peruana, Pisces*, 1845: 32, Pl. 6 (original description, type-locality between Huacho and Chancay). Steindachner, F., *Zool. Jahrb., Suppl.*, IV, 1898: 332, Plate 21, fig. 15 (description, figure). Abbott, J. F., *Proc. Acad. Nat. Sci. Phila.*, 1899: 329 (copy of original description). Garman, S., *Plagiostomia*, 1913: 303 (shortened translation of original description). Norman, J. R., *Discovery Reports, Coast Fishes*, 2, 1937: 11, fig. 3 (Record of several from Atlantic, Gulf of St. George, Argentina, figure).

***Discopyge tschudii* Heckel.**

Range: Reaches the middle of Peru at the edge of our province. Said to extend around Patagonia as far north in the Atlantic as the Rio Plata. (Peru: Between Huacho and Chancay.)

Description: Disk circular; tail less than half the total length. Mouth, eyes and spiracle in the anterior seventh of the total. Mouth small, protractile; teeth bands narrow; teeth minute, flat, inner margins acute angled. Eyes small. Spiracles much larger than the eyes, and a short distance behind; margins without papillae or projections. Gill apertures small, hindmost two behind the middle of the disk. Dorsals small, rounded, subequal; origin of first dorsal slightly in front of the hind margin of the pelvis; second dorsal reaching little behind the origin of the caudal. Pelvis broad, rounded, united behind the vent. Tail small, depressed, dermal folds prominent, posterior margin of caudal convex, supra-caudal portion of fin longer. (Illustration after Günther, 1898, 143 mm.)

Color: Dusky reddish-brown above, darker over the middle; dull whitish below.

FAMILY RHINOBATIDAE.

Key to tropical eastern Pacific genera.

- 1a. Width of disk 1½ to 1¼ times into the length of the disk; nostrils oblique; snout pointed, its angle 60°.....*Rhinobatus*.
- 1b. Width of disk equal to its length; nostrils transverse; snout shorter, obtusely pointed, its angle 85°.....*Zapteryx*.

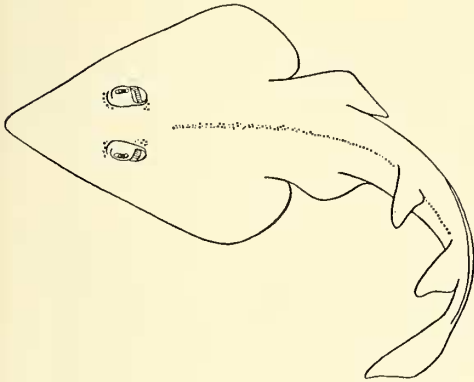
***Rhinobatus* Linck, 1790.**

Key to tropical eastern Pacific species.

- 1a. A single rudimentary spiracular fold.. *planiceps*.
- 1b. Two spiracular folds.
 - 2a. Rostral ridges close together for their anterior halves..... *productus*.
 - 2b. Rostral ridges separated for their whole length.
 - 3a. Rostral ridges rather broad; back with regularly arranged slate-colored blotches *glaucostigma*.
 - 3b. Rostral ridges narrow; back without blotches..... *leucorhynchus*.

Rhinobatus planiceps Garman.

Flat-headed Guitarfish.



Text-figure 6.

Range: Galápagos Islands and Peru. (Peru: Payta, Callao, Pacosmayo, Lobos de Tierra La Punta; Galápagos Islands.)

Field Characters: Flattened shark-like rays; snout narrow and elongate; tail thick and with two dorsals and a well-developed caudal fin; pelvics unnotched on outer edge; skin rough with scattered spines; nostrils oblique; a single, rudimentary spiracular fold. (Illustration after Garman, 1913, 448 mm.)

Color: Light olive green above, with numerous symmetrically placed dark blotches, with rather vague outlines. The dorsals, caudal, and outer parts of paired fins with slight rufous tinge; white below.

Size: The largest recorded specimen is 763 mm. in total length.

Abundance: Apparently common along the Peruvian coast.

Study Material: None.

References: *Rhinobatus planiceps*, Garman, S., *Bull. Mus. Comp. Zool.*, 6, 1879-1880: 168 (original description, 21 specimens from Payta, Callao, and Galápagos Islands). Garman, S., *Proc. U. S. Not. Mus.*, 3, 1880 (1881): 520 (description); Garman, S., *Bull. Mus. Comp. Zool.*, 17, 1888-1889: 89, Plate 24 (description of lateral-line canal system). Jordan, D. S., & Evermann, B. W., *Fish North and Middle America*, 1, 1896: 64 (description). Garman, S., *The Plagiostomia*, 1913: 283, Plate 17a (description, figure; Lobos de Tierra, Peru). Nichols, J. T., & Murphy, R. C., *Bull. Amer. Mus. Not. Hist.*, 46, 1922: 504 (Pascasmayo, Peru). Anonymous, *Bol. Mus. Hist. Nol. "Jovier Prodo,"* No. 9, 1939: 122, 125 (La Punta, Peru).

Rhinobatus productus Ayres.

Northern Guitarfish; Shovel-nosed Shark.

Range: San Francisco south to Agua Verde Bay, Gulf of California. (Mexico: Cedros Island, Port San Bartholome, Turtle Bay, Magdalena Bay, Agua Verde Bay.)

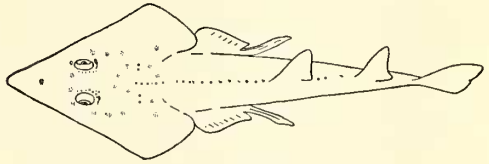
Field Characters: Flattened shark-like rays, snout narrow and elongate; a stout tail furnished with two dorsal fins and a caudal fin. Skin

covered with fine shagreen, with rows of hooked spines down the back and tail, and a small cluster at the shoulder; nostrils oblique; two spiracular folds; rostral ridges approximated along anterior half. Brownish-gray above, with a series of round, slaty spots. (Illustration after Kumada & Hiyama, 1937, 464 mm.)

Size: Reaches a length of over four feet.

Abundance: Reported as common in Turtle Bay.

Study Material: None.



Text-figure 7.

References: *Rhinobatus productus*, Ayres, W. O., MS., Girard, C. F., *Proc. Acad. Not. Sci. Phila.*, 7, 1856: 196 (original description, Monterey, California).

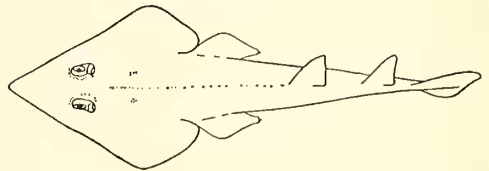
Rhinobatis productus, Osborn, R. C., & Nichols, J. T., *Bull. Amer. Mus. Not. Hist.*, 35, 1916: 142 (Mexico: Cerros I., Port San Bartholome and Agua Verde Bay).

Rhinobatos productus, Wales, J. H., *Copeia*, 1932: 163 (Mexico: Turtle Bay, Magdalena Bay). Norman, J. R., *Proc. Zool. Soc. London*, 1926: 973, fig. 26 (description, figure, synonymy).

Rhinobatus productus, Kumada, T., & Hiyama, Y., *Marine Fish Pacific Coast Mexico*, 1937: 18, Plate 50 (description, figure).

Rhinobatus glaucostigma Jordan & Gilbert.

Slaty-spotted Guitarfish.



Text-figure 8.

Range: Lower California to Ecuador (Mexico: San Bartolome Bay, Guaymas, Mazatlan; Ecuador: Bay of St. Helene).

Field Characters: Flattened, shark-like rays; snout narrow and elongate; tail thick with two dorsals and a well-developed caudal fin; pelvics not notched on outer edge; skin rough with scattered spines; nostrils oblique; two spiracular folds; rostral ridges widely separated and rather broad; back with regularly arranged, slate-colored spots. (Illustration after Kumada & Hiyama, 1937, 382 mm.)

Color: Brownish-gray above, with a series of round, slate-colored spots symmetrically arranged. Pectorals and pelvic fins with pale margins; a dark blotch and some irregular dark patches below the snout. (Norman, *Proc. Zool. Soc. London*, 1926: 970.)

Size: The largest published record is of a fish 762 mm. in length.

Local Distribution: Sandy bottoms in shallow water.

Abundance: There are exceedingly few records of this ray; at Mazatlan it is said to be very common on sandy bottoms.

Study Material: None.

References: *Rhinobatus glaucostigma*, Jordan, D. S., & Gilbert, C. H., *Proc. U. S. Nat. Mus.*, 6, 1884: 210 (original description, color, comparison with *R. productus* and *R. leucorhynchus*, Mazatlan); Evermann, B. W., & Jenkins, O. P., *Proc. U. S. Nat. Mus.*, 14, 1892: 132 (Guaymas, Mexico); Jordan, D. S., *Fishes of Sinaloa*, 1895: 387 (Mazatlan); Jordan, D. S. & Evermann, B. W., *Fishes of North and Middle America*, 1, 1896: 62 (description, color, Gulf of California); Boulenger, G. A., *Boll. Musei della R. Università di Torino*, 13, No. 329, 1898: 1 (Baie de St. Helene, Ecuador); Gilbert, C. H., & Starks, E. C., *Fishes of Panama Bay*, 1904: 14 (comparison with *leucorhynchus*); Garman, S., *Plagiostomia*, 1913: 282 (description, color, Gulf of California); Norman, J. R., *Proc. Zool. Soc. London*, 1926: 970, figure 23 (description, color, range, Mazatlan, figure); Breder, C. M., Jr., *Bull. Bingham Oceano. Coll.*, 2, (1) 1928: 5 (comparison with *leucorhynchus*).

Rhinobatus productus: Streets, T. H., *Bull. U. S. Nat. Mus.*, 7, 1877: 55 (San Bartolome Bay, Lower California).

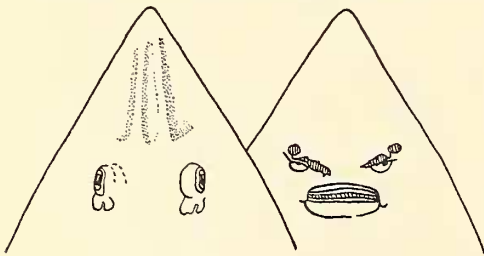
Rhinobatus leucorhynchus: Jordan, D. S., & Gilbert, C. H., *Bull. U. S. Fish Comm.*, 2, 1883: 105 (name only, Mazatlan).

Rhinobatus sp., Kumada, T., & Hiyama, Y., *Marine Fish West Coast Mexico*, 1937: 18, Plate 50, B (short description, figure, west coast Mexico).

Discussion: Kumada & Hiyama's *Rhinobatus* sp. has been placed in the synonymy of this species, although there are points of disagreement in the descriptions.

Rhinobatus leucorhynchus Günther.

White-snouted Guitarfish; Fiddlefish.



Text-figure 9.

Range: Mazatlan, Mexico, south to Guayaquil, Ecuador. (Mexico: Mazatlan, Tenacatita Bay, San Benito; Costa Rica: Gulf of Nicoya; Panama: Bahía Honda, Panama Bay; Colombia: Tumaco; Ecuador: Guayaquil).

Field Characters: Flattened shark-like rays; snout narrow and elongate; tail thick, with two dorsals and a well-developed caudal fin; pelvis unnotched on outer edge; skin rough with scattered spines; nostrils oblique; two spiracular folds; rostral ridges rather narrow; back without spots.

Color: Dark gray above, the snout and outer parts of disk paler, no spots or blotches. Lower parts pale, the distal part of snout dusky. Another fully adult specimen with ten, irregular, roundish spots scattered at random on the back. Younger individuals are said to be generally

lighter in color, with a few pale spots scattered over the upper parts.

Size: A female of 625 mm. has been recorded.

Local Distribution: Sandy bottoms in shallow water.

Breeding: Two young, about to be born, were taken from an adult ray, on April 9, in thirty fathoms, off San Benito in southern Mexico. Each measured 165 mm. in length. A ray 140 mm. long was taken in Tenacatita Bay, Mexico, on December 10.

Study Material: Not taken by us. A single ray of this species which had been caught in the Gulf of Nicoya, was identified in the collection of the museum at San Jose, Costa Rica.

Discussion: There seems considerable likelihood of identity between *leucorhynchus* and *glaucostigma*, as indicated by the following: Gilbert & Starks admit very close relationship between the two forms, but give three apparent differences: pattern, rostral ridges, shape of snout and size of posterior gill-slit.

Stark says that the Ecuadorian specimen of *leucorhynchus* in snout, rostral ridges and disk outline is intermediate between a Panama specimen and a Mazatlan specimen of *glaucostigma*. In *leucorhynchus* the dorsals are thought to be darker and the shagreen is rougher and coarser.

Breder notes the irregularity of the pattern in his individual of *leucorhynchus* and adds, "This suggests the possibility of *R. glaucostigma* Jordan and Gilbert being identical with it or a race."

This can be satisfactorily settled only by a study of a reasonably adequate series of individual rays.

References: *Rhinobates leucorhynchus*: Günther, A., *Proc. Zool. Soc. London*, 1866: 604 (original description, Panama).

Rhinobatus leucorhynchus: Günther, A., *Trans. Zool. Soc. London*, 6, 1869: 396, 490. (description of type, Pacific coast of Panama); Günther, A., *Cat. Fish. Brit. Mus.*, 8, 1870: 444 (description and illustration of head); Garman, S., *Proc. U. S. Nat. Mus.*, 3, 1881: 517 (description, Panama); Jordan, D. S., & Gilbert, C. H., *Bull. U. S. Fish Comm.*, 2, 1882: 105 (Mazatlan, Mexico); Jordan, D. S., *Proc. U. S. Nat. Mus.*, 8, 1886: 364 (Panama); Jordan, D. S., & Evermann, B. W., *Fishes North and Middle America*, 1896: 62 (description, color, Panama and vicinity); Gilbert, C. H., & Starks, E. C., *Fishes Panama Bay*, 1904: 14 (comparison with *glaucostigma*); Starks, E. C., *Proc. U. S. Nat. Mus.*, 30, 1906: 762, 763 (comparison with *glaucostigma*, Gulf of California, Panama, Ecuador); Garman, S., *The Plagiostomia*, 1913: 282 (description, color); Wilson, C., *Ann. Carnegie Mus.*, 10, 1916: 58 (Tumaco, Colombia); Meek, S. E., & Hildebrand, S. F., *Marine Fishes Panama*, 1923: 68 (description, color, Mazatlan to Ecuador); Norman, J. R., *Proc. Zool. Soc. London*, 1926: 971 (description, illus. of head, type length); Breder, C. M., Jr., *Bull. Bingham Oceano. Coll.* 2 (1), 1928: 4 (color, comparison with *glaucostigma*; San Benito, Mexico; Bahía Honda, Panama).

Rhinobates leucorhynchus: Seale, A., *Allan Hancock Pacific Exped.*, 9, No. 1, 1940: 2 (Tenacatita Bay, Mexico).

Zapteryx Jordan & Gilbert, 1880.

Zapteryx exasperata (Jordan & Gilbert).

Rough-skinned Guitarfish.

Range: San Diego and the Gulf of California south to Panama. (Mexico: Gonzago Bay, San Felipe Bay, Espiritu Santos Island; Panama: Panama Bay.)

Field Characters: Shark-like rays with an elongate, depressed body; snout produced into a flat, very long rostrum, armed on each side with 24 to 32 teeth.

Study Material: No live fish observed or collected; two small rostrums were purchased at Acapulco, Mexico, Nov. 26, 1937. They measure 172 and 175 mm. from the tips to the proximal pair of teeth; width at this base 28 mm.; number of teeth 27 right, 27 left, and 26 right, 28 left respectively (Nos. 28,724, 28,725).

References: ? *Pristis pectinatus*, Latham, J., *Trans. Linn. Soc. London*, 2, 1794: 278 ("in the ocean."). Breder, C. M., Jr., *Bull. Bingham Oceanogr. Coll.*, 2 (1), 1928: 4 (no definite locality, west coast of Central America or Mexico; 2 specimens, 710 and 724 mm. and rostrum of a third specimen).

Discussion: Further study may show these Pacific sawfish to be another species.

Family RAJIDAE.

Key to tropical eastern Pacific genera.

- 1a. Rostral cartilage produced forward from the skull, stiffening the rostrum.....*Raja*.
- 1b. Rostrum soft, flexible, lacking the rostral prolongation of the cranium.....*Pammobatus*.

Raja Linnaeus, 1758.²

Key to tropical eastern Pacific species.

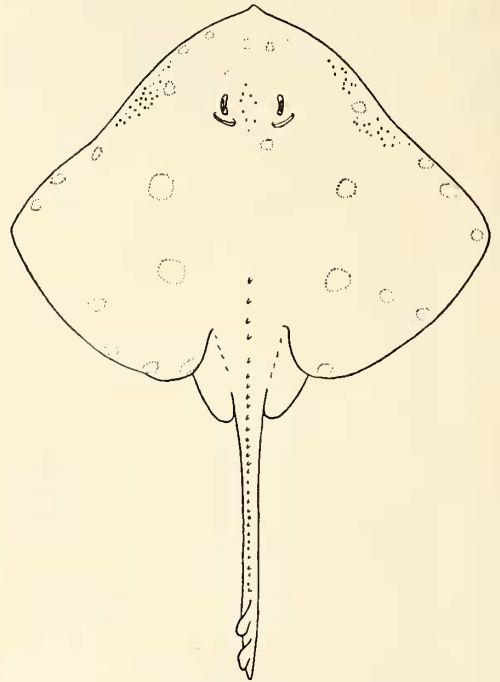
- 1a. No spines present about the eye; 33 rows of teeth.....*aguja*.
- 1b. Spines present about the eye; 37 to 44 rows of teeth.
 - 2a. Three large spines about the eye, one in front and two behind (see illustration).....*badia*.
 - 2b. Usually more than three spines about the eye, the spines smaller in size.
 - 3a. Three or four rows of spines between the eye and the edge of the disk; a spine on each shoulder; an obscure darkish patch near the base of the pectoral fin on the dorsal surfaces.....*equatorialis*.
 - 3b. No rows of spines below the eyes; no tubercles or spines on the shoulders.
 - 4a. A series of spines or prickles along the middle of the back, a few of the anterior ones being quite large; a dark ring on the upper surface near the base of the pectoral fin (Cedros Island, northward).....*inornata*.
 - 4b. A single median spine on the back; no dark ring near the base of the pectoral fin on the upper surface (Ecuador).....*ecuadoriensis*.

² This key should be used with great caution, as our knowledge of the tropical eastern Pacific forms of this genus is fragmentary.

Two species of the genus *Raja* have been reported by Kumada & Hiyama from the "west coast of Mexico." Whether these fish belong to the tropical eastern Pacific fauna or to that of the colder waters further north we do not know. Because of scanty material and lack of familiarity with the group, we do not attempt to give these specimens a name or to place them in the synonymy of some other form. We have included copies of Kumada & Hiyama's descriptions under the heading of "*Raja* sp. A." and "*Raja* sp. B."

Raja aguja Kendall & Radcliffe.

Peruvian Ray.



Text-figure 12.

Range: Near Aguja Point, Peru (Lat. 5° 47' S., Long. 81° 24' W.), in 536 fathoms.

Field Characters: Caudal fin absent or only a slight fold of skin; two dorsal fins crowded together near tail tip; pelvics notched on outer edge; skin rough; thirty-three rows of teeth. Color, purplish-brown, with or without scattered pale, good-sized spots. (Illustration after Kendall & Radcliffe, 1912, 480 mm.)

Size: Grows to 480 mm.

Study Material: None.

References: *Raja aguja*, Kendall, W. C., & Radcliffe, L., *Mem. Mus. Comp. Zool.*, 35, 1912: 78, 167, Plate 1, figs. 1 and 2 (original description, color; type locality: near Aguja Point, Peru).

Raja aguja, Garman, S., *The Plagiostomia*, 1913: 358 (re-description of one of the types).

Discussion: The female specimen in the original description appears as if it might be assigned to *Pammobatus*.

Raja badia Garman.

Range: Gulf of Panama. (Thirty miles east of Capa Mala, Lat. 7° 5' 30" North, Long. 79° 40' West), in 1270 fathoms.

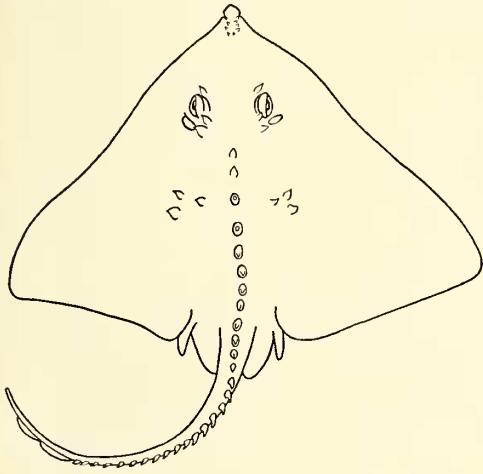
Field Characters: Ray with caudal fin absent, a low dermal keel on upper and lower sides of tip of tail; two dorsal fins crowded together near tip

of tail; pelvic fin notched on outer edge; skin rough, with a single median row of large tubercles down back and tail, conspicuous, large spines about the eye. (Illustration after Garman, 1899, 257 mm.)

Color: Chocolate brown above and below; narrow white areas about the mouth, and a white spot immediately behind the middle of the shoulder girdle.

Size: Length of only known specimen, 257 mm.

Study Material: None.



Text-figure 13.

Breeding: Two egg-cases which, as Garman writes, are "probably *R. badia*," were taken in two hauls by the *Albatross*, on Feb. 24, at almost the same locality, about fifty miles south-west of Mariata Point, Panama, in 465 and 782 fathoms respectively. Garman figures one of them and describes them as follows: "The egg case itself, without the tendrils, is 64 by 90 mm. The horns are mutilated, evidently they were of considerable length; their bases are stout and thick. Over the entire surface the case is covered with fine villi or pile, in longitudinal series, which though harsh to the touch, gives the appearance of a soft rich, black velvet. The second specimen has a longer, closer pile."

References: *Raja badia*, Garman, S., *Mem. Mus. Comp. Zool.* 24, 1899: 22, Plate 6, figs. 1-3 (original description, color, egg cases; type locality, Panama Bay).

Raja badia, Garman, S., *The Plagiostomia*, 1913: 357 (description, color).

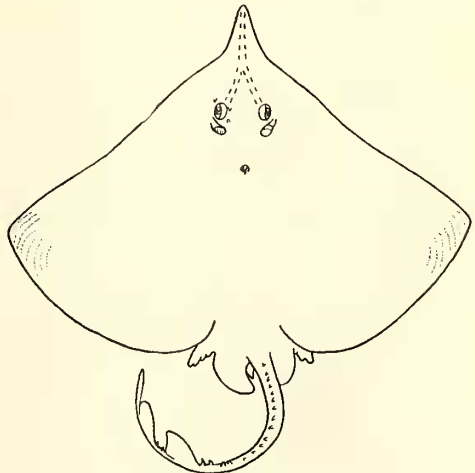
Raja ecuadoriensis nom. nov.³

Range: San Helena Bay, Ecuador.

Description: The figure adjacent and the following translation are from Tortonese's description and account.

"*Raja steindachneri*. Delf. (Tav. 1).

"Length 388 mm., disk length 224 mm. at the widest place, which is one-third wider than long. The line which connects the tip of the snout with the center of that which goes from one tip of the pectorals to the other is somewhat less than half of this latter. The line from the tip of the snout to that of one pectoral intersects the margin of the body slightly near the tip of the pectorals, and comprises one and a half times the length of the disk. The pectorals have convex angles, almost acute. The posterior ones are rounded. The anterior margin is slightly sinuous, forming on each side two slightly marked re-entrances which render it prominent in relation to the eyes. The pectorals reach to the middle of the ventrals, which are clearly bilobar and measure three-quarters of the length of the snout. The latter is long and acute, much straitened toward the tip which is rounded; the longitudinal diameter of the eye is comprised five and a half times in its length, the interorbital space three times. Rostrate angle of about 45°. The snout is a little less than a third of the length of the disk. The rostrate cartilage is narrow and robust, united in its distal three-fifths, forked at its base. The interorbital space is markedly concave. The orbits have small *spiracula*. The mouth is a little curved; its width is comprised one and three-fifths times in the pre-nasal part of the snout. 37/37 teeth, with a central triangular point. The nasal valves are fringed on the margin turned toward the mouth. Small *pterygopodia*; the free part measures 8 mm. The tail is depressed, with a longitudinal cutaneous fold on each side extending to the caudal one. The length of the approximately equal dorsal fins is a third of the snout; they are separated by a space rather smaller than half the base of the first dorsal fin; the second is united with the caudal one, which is placed low, and double the length of the eye.



Text-figure 14.

³ Nom. nov. for *Raja steindachneri* Tortonese, 1939, not of Delfin, 1901.

"Nearly all of the body is smooth. Two spines, with some other minute ones, stand before the orbit, two placed right above it, and some very small ones above the *spiracula*. A little behind these, and in the middle of the back stands a single strong isolated spine. Near the outer angle of the pectorals run 8 unequal series of small spines, arched more or less parallel to one another, and parallel also to the margin of the body, extending farther backward than forward. The dorsal median line of the tail is occupied by a series of 17 robust spines inserted into elliptical and laterally compressed *scutelli* that are not very much unequal in their dimensions; two other spines are placed between the dorsals. A fine band of tiny spinules follows the ventral margin, characteristics which distinguish the male: its total length is 393 mm., of which 178 make up the tail, but the *pterygopodia* measure 118 mm. This fact, combined with other small morphological differences might lead to the supposition that the Ecuador race represents a heretofore unknown species. It is however, impossible for me to ascertain this now, and since I am acquainted with *R. steindachneri* only through the treatise cited, I feel justified in the assumption that the specimen studied belongs to this species, observed until now near the coasts of Chile (type of Iquique) and Peru, but spreading also farther North.

"The races, limited perhaps to a small number of forms, which live in the western regions of South America, are not yet well known; concerning them comparative studies of a certain breadth are still lacking."

Reference: *Raja steindachneri* (not of Delfin) Tortonese, E., *Boll. Musei Zool. Anat. comp. Torino*, 1939 (3) 47, no. 89: 3-5, Plate 1 (description, figure, Ecuador).

Discussion: Tortonese's description and figure are based, according to his text, upon Evermann & Kendall's description of a ray⁴ that the latter assigned to *Raja steindachneri* Delfin, which in turn was based upon Steindachner's *Raja chilensis*, 1896. A comparison of Tortonese's figure with the original plate and description of *Raja chilensis* shows that the latter is quite properly placed in the synonymy of *Psammobatus lima* Poepfig, that Tortonese's fish with its prominent rostral cartilage was correctly assigned to the genus *Raja* and that it bears no resemblance to Steindachner's *chilensis*. It is therefore necessary to give another name to Tortonese's ray.

Raja equatorialis Jordan & Bollman.

Range: Gulf of Panama in 33 fathoms, 7 miles south of Pearl Islands. (8° 6' 30" N., 78° 51' W.)

Field Characters: Rays without distinct caudal fin; two dorsal fins near tip of tail; pelvic fin notched at outer end; large spines present around eye; three prominent rows of spines or tubercles on the tail.

Color: Light brown, spotted with paler, back

with obscure reticulations of the ground color, forming honey-comb-like markings surrounding paler markings; an obscure, roundish dusky blotch at middle of base of pectorals, and a darker one near their posterior base; edges of ventral and pectoral fins and the snout pale; dark markings on interorbital area and below eye. No markings below.

Size: The only known specimen is 14 inches long.

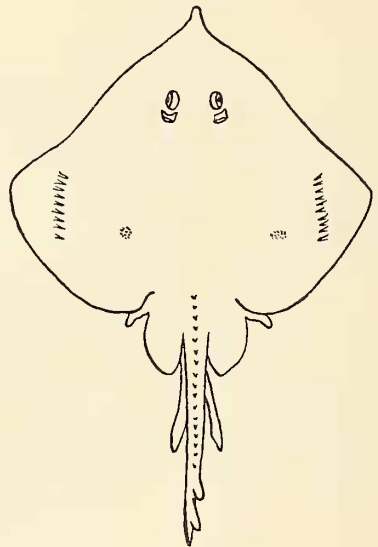
Study Material: None.

References: *Raja equatorialis*, Jordan, D. S., & Bollman, C. H., *Proc. U. S. Nat. Mus.*, 12, 1890: 150 (original description, color; type locality, Gulf of Panama; type No. 41,132, U. S. Nat. Mus.). Meek, S. E., & Hildebrand, S. F., *Marine Fishes of Panama*, 1, 1923: 71 (description, color). Gilbert, C. H., *Proc. U. S. Nat. Mus.*, 48, 1915: 308 (re-examination and description of the type).

Discussion: This ray is related to *Raja inornata*, from which it is apparently distinguished by having four rows of spines below the eyes, a series of stout spines on each side of the tail in the male, and no prickles on the back except the median series and the spine on each shoulder. Considering the variability found in *R. inornata*, a comparison between the type of *equatorialis* and specimens of *inornata* would be advisable. However, Gilbert (l. c.) states in his reexamination of the type of *equatorialis* that "*R. equatorialis* is not very closely related to any other American species."

Raja inornata Jordan & Gilbert.

California Skate.



Text-figure 15.

Range: Straits of San Juan de Fuca south to Cedros Island, Lower California.

Field Characters: Disk broad, diamond-shaped, anterior margins undulating. Caudal absent, two dorsals near tail tip; pelvics notched; small

⁴ Evermann, B. W., & Kendall, L., *Bull. U. S. Nat. Mus.*, 95, 1917: 14.

prickles along the mid back, larger ones on snout and between eyes, and 3 to 5 rows on back of tail. (Illustration after Barnhart, 1936.)

Color: Dark olive brown above, with a small dark ring at the base of each pectoral, and sometimes two other pale spots on the pectorals. Our half-grown specimen has the back covered with many, faint, dark spots and a lesser number of light ones; a narrow, pale blue edge around pelvic fins. Lower parts pale, mottled with dusky on central portions of fish.

Size: Reaches a length of two and a half feet.

Local Distribution: On the bottom of shallow water along the coast, as deep as seventy-six fathoms.

Abundance: From San Diego northward said to be very abundant.

Food: Specimen No. 25,688 had six small shrimps in its stomach; *Solenocera mutator* Burkenroad, 1 male; *Crago zaca* Chace, 4 females (1 ovigerous); *Crago resima* (Rathbun), 1 ovigerous female. All had been swallowed whole.

Study Material: 1 specimen. Dredged from Station 126:D-8, (East of Cedros Island, Lower California) in 48 fathoms on muddy bottom, female (25,688) length, 365 mm., May 22, 1936.

References: *Raja binoculata*, Jordan, D. S., & Gilbert, C. H., *Proc. U. S. Nat. Mus.*, 3, 1880: 134 (description, indefinite locality, San Francisco and Pacific Coast).

Raja inornata, Jordan, D. S., & Gilbert, C. H., *Proc. U. S. Nat. Mus.*, 4, 1881: 73 (reference to description given in preceding reference). Garman, S., *The Plagiostomia*, 1913: 347 (description of young specimen).

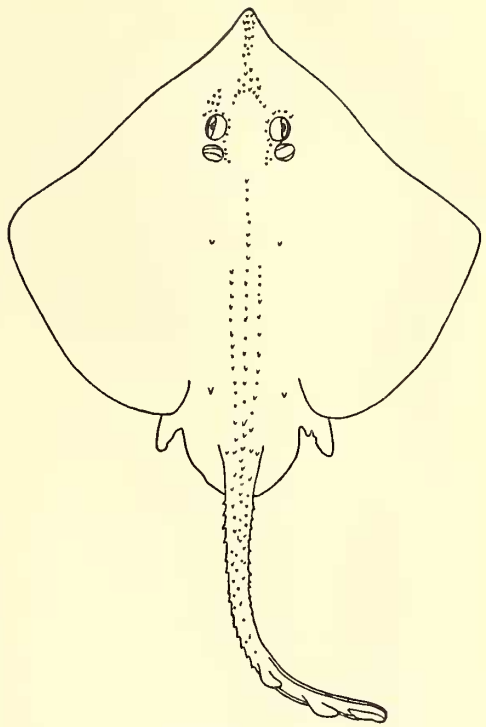
Raja inornata, Gilbert, C. H., *Rep. U. S. Fish Comm.*, 19, 1893 (1895): 462, 475 (description embryo, young and adults). Gilbert, C. H., *Proc. U. S. Nat. Mus.*, 48, 1915: 306 (description of embryo in egg case). Hubbs, C. H., *Copeia*, 86, 1920: 81 (development of dorsal spines).

Discussion: The half-grown female in our collection extends the range southward three hundred miles.

Raja sp. A.

Range: "Pacific Coast of Mexico." (Kumada & Hiyama).

Description: "Disk broader than long, anterior edge of pectoral convex; snout sharply pointed. Body, except ventrals covered with small sharp prickles. 10 to 15 small distinct spines along upper margin of orbit, from anterior end of orbit to posterior end of spiracle. Several spines in a group on shoulder; a pair of blunt processes in pelvic region. A row of sharp, rather hooked, spines along middle of back, from posterior of spiracle to caudal; beside this, 4 rows of smaller spines run parallel to median row, those becoming larger and hooked at tail, spines of inner rows few in number in tail, those of outer rows more numerous than median row. Back brownish gray, except sides of snout; a pair of large ocelli, consisting of black concentric ring, surrounded by a fainter area, at the middle of the pectoral fin. Lower surface white, posterior margin of pectorals and ventrals rather grayish, tail dark. Lower side of the snout and the anterior half of the anterior margin of the pectoral covered with



Text-figure 16.

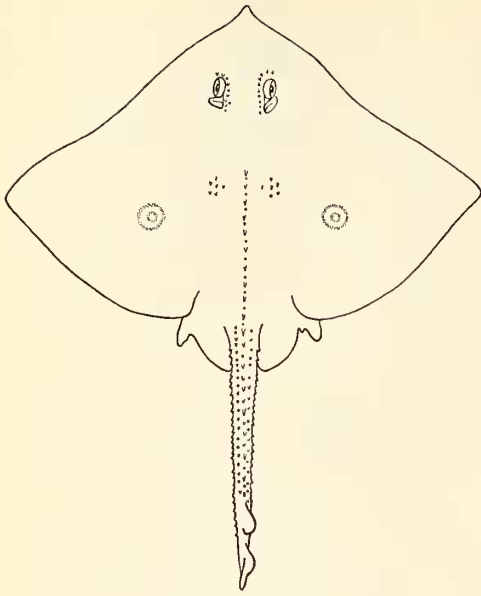
small prickles; other parts of lower surface smooth. The fish closely resembles *Raja stellulata* Jordan and Gilbert, but differs from it in having 5 rows of prickles on body and tail, and distinct concentric ocelli on middle of pectoral. Reaches 3 feet."

Reference: *Raja* sp., Kumada, T., & Hiyama, Y., *Marine Fishes West Coast of Mexico*, 1937: 19, Plate 53.

Raja sp. B.

Range: "Pacific Coast of Mexico." (Kumada & Hiyama).

Description: "Outline of the body closely resembles that of above species [*Raja* sp. A]. Body covered with less prickles; upper surface almost naked: anterior margin of the angle of the pectoral fin and the center of the body slightly roughened by small tubercles; lower surface of the body smooth, except anterior half of the margin of the pectorals. Spines of body rather smaller than forgoing species, not hooked; ten or more small spines on upper margin of the orbit, from anterior of eye to end of spiracle; a pair of groups of spines, each consisting of two or three flat tubercles, on shoulder; a pair of blunt spines on pelvic region; a row of large spines along middle of the body from behind spiracles to caudal, besides this a pair of rows of spines from middle of body to caudal parallel to median row, outer side of them, another



Text-figure 17.

pair of the rows of spines extends along middle line in tail; these all similar in size. Colour brownish gray above, speckled with small dark spots. Lower surface of body white, posterior margins of the pectoral and ventral grayish, lower side of the tail dark. Rather small in size. This also resembles *Raja stellulata*, but differs in the distribution of the spines on the upper side of the body and the tail, and in coloration."

Reference: *Raja* sp., Kumada, T., & Hiyama, Y., Marine Fishes West Coast of Mexico, 1937: 20, Plate 54, Fig. A.

***Psammobatis* Günther, 1870.**

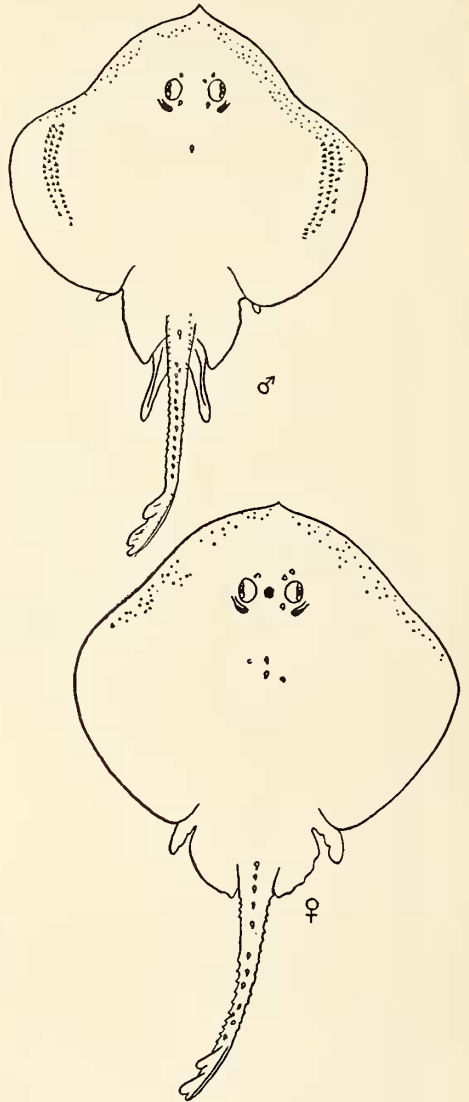
Key to tropical eastern Pacific species.⁵

- 1a. Interorbital width equal to or slightly more than the longitudinal diameter of the eye. *scobina*.
- 1b. Interorbital width 2 to 4 times the longitudinal diameter of the eye.
 - 2a. A median series of 6 or 8 spines on middle of the back. *brevicaudatus*.
 - 2b. No median series of spines on the middle of the back.
 - 3a. 10 to 11 large spines along the upper surface of the tail; upper surfaces of disk with minute spinules in a patch on the anterior margin of the pectoral fins, on snout, round the eyes and along middle of back; lower surfaces with a narrow patch of spinules along the anterior margin of the pectorals. *lima*.
 - 3b. 25 spines along the upper surface of the tail; disk above and below covered with spinules, these are more abundant in a

⁵This key has been adapted and modified from the recent revision of the genus by Norman (*Discovery Reports*, 16, 1937: 28-35, figs. 10, 11). Keys and complete synonymies can be obtained from this paper. See also *Raja aguja*.

round cluster between the eyes and on the forehead and snout; lower surfaces lacking these spinules in a small area immediately around and behind the anus *spinosissimus*.

***Psammobatis scobina* (Philippi).**



Text-figure 18.

Range: Argentina, Patagonia, Chile, Ecuador. (Ecuador: San Elena Bay).

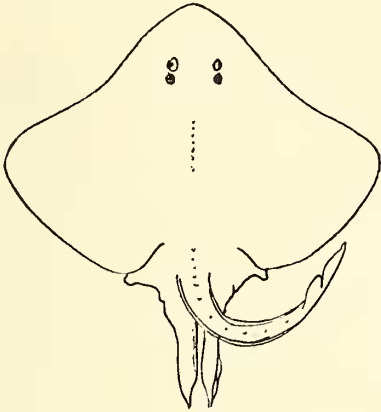
Field Characters: Somewhat diamond-shaped rays without caudal fin and with two dorsal fins crowded far back on the tail; snout soft, without an internal rostral prolongation of the cranium; interorbital space equal to or slightly greater than the diameter of the eye. Brownish or grayish, spotted or mottled with dark brown and

with some small indistinct ocelli scattered over the disk; lower surface uniformly white. (Illustration after Norman, 1937, 352 and 384 mm.)

Study Material: None.

References: See Norman, l. c., 29, 30. Add the following: *Malacorchina mira*, Tortonese, E., *Boll. Mus. Zool. Anat. Comp. Univers. Torino*, 47, ser. 3, No. 89, 1937: 5 (Ecuador: Bahia di S. Elena).

Psammobatis brevicaudatus Cope.



Text-figure 19.

Range: Ecuador and Peru. (Ecuador: San Elena Bay; Peru: Pacasmayo Bay.)

Field Characters: Small rays lacking a caudal fin and with two dorsal fins placed far back on the tail; snout soft, without an internal rostral prolongation of the cranium; interorbital space greater than length of eye plus the spiracle. Back plumbeous with darker shades; middle of anterior part of snout with a dark spot behind it. (Illustration after Fowler, 1910.)

Size: The two known specimens are 307 and 383 mm. long.

Study Material: None.

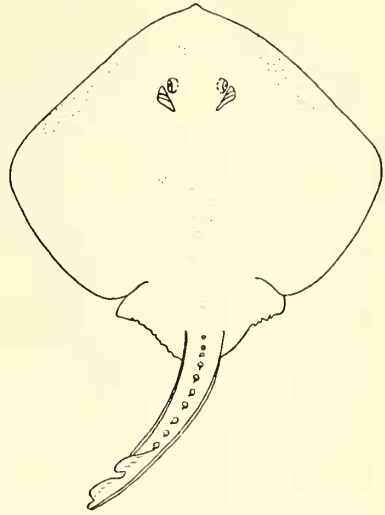
References: *Psammobatus brevicaudatus*, Cope, E. D., *Proc. Amer. Philo. Soc.*, 17, 1877: 48 (original description; type locality, Pacasmayo Bay, Peru). Fowler, H. W., *Proc. Acad. Nat. Sci. Phila.*, 1910: 471, fig. 2 (name only, figure of type). Garman, S., *The Plagiostomia*, 1913: 371 (description, color). Norman, J. R., *Discovery Reports*, 16, 1937: 35 (description).

Malacorchina brevicaudata, Tortonese, E., *Boll. Mus. Zool. Anat. Comp. Torino*, (3) 47, 1939: 6 (description, color; Ecuador: Baía de San Elena).

Psammobatis lima (Poepfig).

Range: Peru and Chile.

Field Characters: Diamond-shaped rays without caudal fin; two dorsal fins placed far back on a stout tail; snout soft, lacking the rostral prolongation of the cranium; length of snout $5\frac{1}{2}$ to $6\frac{1}{3}$ in width of the disk. Upper surface of disk mainly smooth, with areas of minute spinules on anterior margins of the pectoral fins, on the snout, round the eyes and along the back; large spines sometimes present on the upper surface of the tail, sometimes an irregular row of spines



Text-figure 20.

from nape joining the row on the tail. More or less uniformly grayish or brownish above; lower surfaces white, the outer parts of the pectorals gray. (Illustration after Norman, 1937: 436 mm.)

Size: ? Grows to 460 mm. in length.

Study Materials: None.

References: See Norman, *Discovery Reports*, 16, 1937: 34, for latest résumé of references and synonymy.

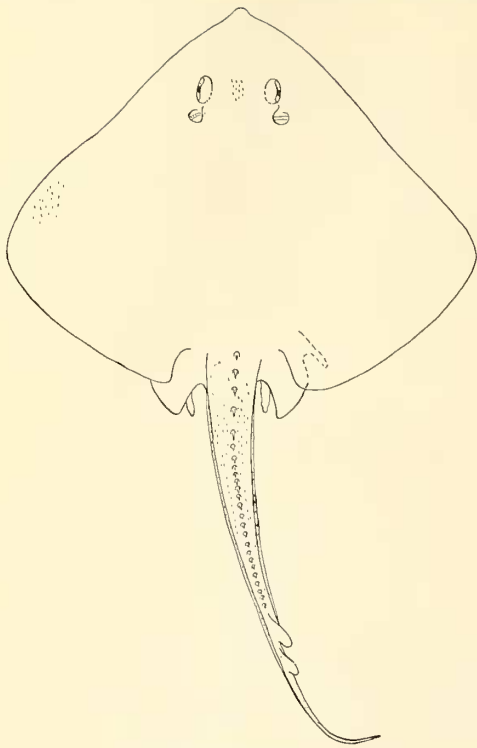
Psammobatus spinosissimus sp. nov.

(Plate II, Fig. 4).

Type: Holotype, embryo male taken from egg case, No. 6132, *Arcturus* Oceanographic Expedition, Department of Tropical Research, New York Zoological Society. Station 72:D-3 (4° 50' N., 87° 00' W.) sixty miles south of Cocos Island, June 3, 1925, in 765 fathoms; total length 248 mm., type in the collection of the Department of Tropical Research.

Measurements: (Percentages of the total length stated in parentheses). Total length 248 mm., disk length 115 mm. (46.5%), disk width 145 (58.5%), tail length 135 (54.5%), snout to mouth 27 (11%), snout to eye 23 (9.3%) snout to nostril 20 (8.1%), snout to end of pelvic fins 125 (50.5%), snout to vent 103 (41.5%), snout to 1st gill slit 47 (19%), interorbital space 23 (9.3%), internarial space 23 (9.3%), mouth width 21 (8.5%), space between 1st gill-slits 44 (17.8%), space between 5th gill-slits 30 (12.1%), eye 8 (3.2%), spiracle 5 (2%), eye + spiracle 12 (4.7%), 2nd dorsal fin to tip of caudal 39 (15.7%), snout to transverse line across disk at greatest width 72 (29%).

Description: Disk diamond-shaped, broader than long with its greatest width at a point 62% of the disk length from the snout; anterior



Text-figure 21.

margin with a conspicuous bulge in front of the eye; tip of snout produced into a small blunt nubbin, no indication of a barbel. Disk above and below covered thickly and evenly with small, recurved spines, extending to the tip of the snout and to the edge of the disk; these spines are somewhat more abundant in a round cluster between the eyes and on the forehead and snout; only the claspers and an area immediately around and behind the anus are free from spines. The first enlarged median spine occurs at the level of the inner, free margin of the pectorals about 110 mm. back of the snout. The spines increase gradually in size to the fifteenth, then are succeeded in a continuous unbroken line by a further series of ten, smaller, subequal and closer together, ending at the first dorsal fin. Tail covered everywhere with small spines, even over the surface of the dorsal fins. Tail with two well developed fin folds extending back along each side almost to the tail tip; a small, low filamentous fold along the dorsal surface of the tail beginning close behind the 2nd dorsal fin and extending to the tip of the caudal. Outer separated portion of the pelvics appearing like a thickened finger, similar in general shape and size to the clasper; the latter are 10 mm. in length. Superior oral velum low and smooth, with a short cluster of about a dozen fimbriae at each corner of the mouth. Teeth are only partly developed, small, flat-cusped, separate, numbering about thirty across the extent of the mouth.

Color in life uniform greenish slaty-gray both above and below, with the margins of the disk narrowly dusky. In the preserved fish, the color both above and below is pale brown with the outer border of the pectoral somewhat darker.

The weight of the embryo when first removed from the egg case was 170 grams.

Egg Case: This was olive green in color, and measured 160 mm. by 110 mm., by 43 mm. thick. The longest of the four tentacles was 100 mm. long.

Study Material: The type and only known specimen; Color Plate A950, and the egg case.

References: Deep Sea Ray, Beebe, W., *The Arcturus Adventure*, New York, 1926: fig. 32 (photograph of specimen and egg case).

Discussion: This species runs to *lima* in Norman's key to the genus but differs from that species in the distribution of spines on the dorsal and ventral surfaces, in the different size and shape of the spiracle, greater number of spines on the dorsal surface of the tail, and in the length of the tail posterior to the second dorsal fin (possibly the tip of the tail is broken off in most specimens of this genus; in our specimen, which was taken from an egg case, the caudal is long and tapering and has a filamentous fold on the upper surface).

Family DASYATIDAE.

Key to tropical eastern Pacific genera.

- 1a. Caudal fin absent.
 - 2a. Tail very long, whip-like.....*Dasyatis*.
 - 2b. Tail very small, much shorter than the disk.....*Gymnura*.
- 1b. Caudal fin present.
 - 3a. Caudal fin broad, convex posteriorly; tail somewhat shorter than the disk.....*Urobatus*.
 - 3b. Caudal fin narrow and pointed; tail longer than the disk.....*Urotrygon*.

Dasyatis Rafinesque, 1810.

Key to tropical eastern Pacific species.

- 1a. Tail with a keel or fold on its upper surface.
 - 2a. Tail with a keel above and a fold below.....*longus*.
 - 2b. Tail with folds both above and below.....*brevis*.
- 1b. Tail without keel or folds above; a low keel below.....*pacificus*.

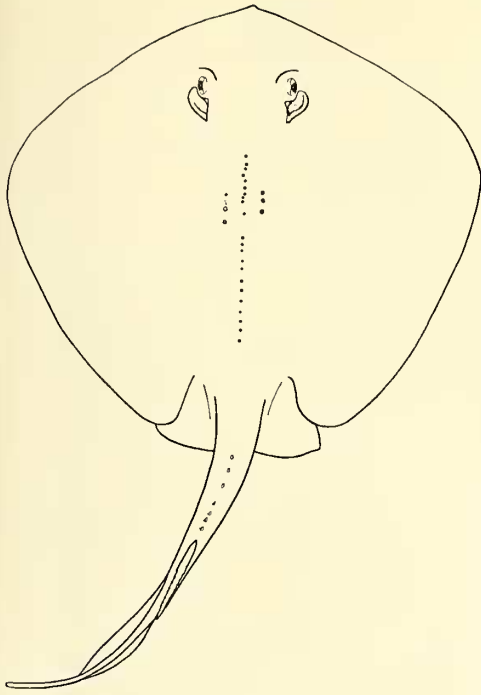
Dasyatis brevis (Garman).

Rat-tailed Ray; Kite-shaped Ray.

(Plate III, Fig. 1).

Range: San Diego south to Peru and the Galápagos Islands. (Mexico: San Francisquito Bay, Mulege, Inez Bay, La Paz; Costa Rica: Gulf of Nicoya; Peru: Payta, Paracas Bay).

Field Characters: Tail slender, longer than body when unbroken; a strong spine on tail; no dorsal or caudal fins, but a long, vertical fold of skin above and below the tail; disk kite-shaped, with greatest width two-fifths of disk length back of snout. (Illustration from specimen 24,995: 702 mm. long, 463 mm. snout to caudal spine base.)



Text-figure 22.

Color: Dark brown or black, unmarked.

Size and Weight: Six feet or more in length. A four-foot male weighed fifty pounds.

Food: A 27-inch female from Inez Bay had thirty or more small crabs in its stomach, all of the same species.

Study Material: 5 specimens. Mexico: Inez Bay, female (24,943), total length 1257 mm. (4 feet, 1½ inches), April 10, 1936, speared at night. Mexico: Inez Bay, male (24,995) total length 702 mm. (27½ inches), April 13, 1936, speared at night. Costa Rica: Gulf of Nicoya, 2 specimens, in collection of Museo Nacional, San Jose, Costa Rica; Galápagos Islands: Gardiner Bay, Hood Islands: female (5506), April 25, 1925, disk length 371 mm.

Dimensions: (In Percentage of Total Length.)

	Male (24,943)	Female (24,995)
Total length	1257 mm.	702 mm.
Disk length	53.5%	47.2%
Disk width	57	—
Tail length	58.4	52.8
Snout to mouth	9.8	7.8
Snout to eye	12.4	11.
Snout to anterior nostril	7.3	6.4
Snout to end of pelvics	57.	50.
Snout to 1st gill-arch	15.	14.3
Interorbital space	11.	10.2
Internarial	10.6	
Anterior internarial space	5.4	4.8
Mouth width	4.3	5.
Space between 1st gill-arches	13.3	11.
Space between 5th gill-arches	8.	7.

Vertebral spines:

Male: about 90; continuous from back of eye to tail spine.

Female: 25; continuous half way to tail, then 2 and 1.

Humeral spines:

Male: 15.

Female: 5.

Teeth of Male: Upper jaw: 11 straight rows, 20 oblique rows.

Lower jaw: 18 straight rows; 26 oblique rows.

Discussion: Our Galápagos Island specimen has strong dorsal spines, considerably stronger than is shown in the various figures of this species. The specimen has its tail broken; judging from similar sized specimens, its total length was about 40 inches. Probably the heavy spines are associated with its size and age.

References: *Trygon brevis*, Garman, S., *Bull. Mus. Comp. Zool.*, 6, 1879: 171 (original description; type locality, Payta, Peru?).

Dasyatis dipterurus, Jordan, D. S., & Gilbert, C. H., *Proc. U. S. Nat. Mus.*, 3, 1880 (1881): 31 (original description, type locality San Diego, California).

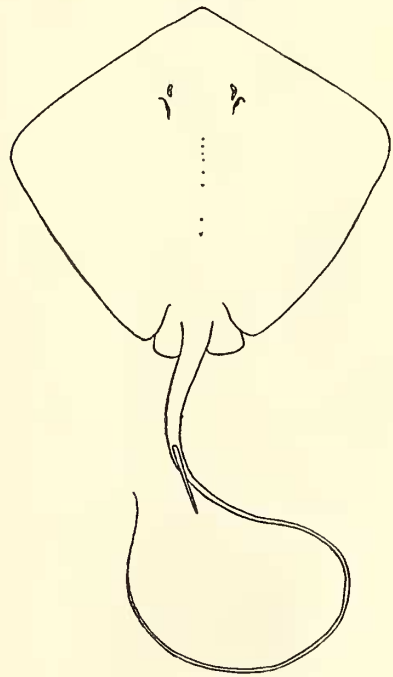
Dasyatis brevis, Garman, S., *The Plagiostomia*, 1913: 396, Plate 32, figs. 5, 6 (description; figure, Payta Peru).

Breder, C. M., Jr., *Bull. Bingham Oceanogr. Coll.*, 2 (1) 1928: 1 (San Francisco Bay, Lower California).

Dasyatis dipterura, Osburn, R. C., & Nichols, J. T., *Bull. Amer. Mus. Nat. Hist.*, 35, 1916: 145 (Mulege, Lower California). Wales, J. H., *Copeia*, 1932: 163 (La Paz, Lower California).

Dasyatis brevis, Nichols, J. T., & Murphy, R. C., *Bull. Amer. Mus. Nat. Hist.*, 46, 1922: 504 (Paracas, Peru). *Amphlostistius dipterurus*, Beebe, W., "Zaca Venture," 1938: 120, 301 (Santa Inez Bay, Lower California).

Dasyatus longus (Garman).



Text-figure 23.

Range: Gulf of California to the Galápagos. (Mexico: Mazatlan, Acapulco; Costa Rica: Port Parker; Panama: Panama Bay; Galápagos: Narborough, Hood Islands.)

Field Characters: Tail slender, from one and four-fifths to more than twice length of disk; a strong spine on tail; no dorsal or caudal fins, but a low keel above and a fold of skin beneath the tail; disk rhomboid, greatest width two-fifths back of snout; anterior margins of disk straight, snout not protruding; snout angle blunt, 117° ; spines along mid-back, and sometimes on interorbital and on tail. Color, uniform brown above. (Illustration after Garman, 1913, 1,000 mm.)

Size: A male seined at Port Parker, Costa Rica, measured in total length 2,574 mm. (8 feet, $9\frac{1}{2}$ inches) and weighed 102 pounds.

Abundance: Not a common ray, usually only single specimens have been captured in any one locality. An exception was at Port Parker, Costa Rica, where we seined two and saw eight more large individuals.

Study Material: 2 specimens, not saved; Port Parker, Costa Rica, both males; lengths, 2,574 and 1,769 mm., Jan. 21, 1938; seined.

Measurements: in percentages of total length.

	1st Specimen		2nd Specimen	
	mm.	%	mm.	%
Total length.....	2574		1769	
Disk length.....	978	38.4	660	37.3
Disk width.....	1162	45.6	787	44.5
Tail length.....	1854	72.7	1295	73.
Eye.....	21	.82		
Snout.....	241	9.4		
Interorbital.....	176	7.		
Internarial.....	110	4.3		
Snout to mouth....	228	8.9		
Mouth width.....	85	3.3		
1st to 5th gills....	146	5.7		
Length to base of tail	354	14.		
Base of tail to spine	406	16.	233	13.2
Spine length.....	160	6.3	150	8.5

Discussion: The characters of disk spines, oral papillae, and tail length are so variable, that if the caudal keel and fold of skin in an adequate series of specimens, prove to be also variable or sex characters, the two species *longus* and *brevis* should be merged.

References: *Trygon longa*, Garman, S., *Bull. Mus. Comp. Zool.*, 6, 1880: 170 (original description; type locality, Acapulco, Mexico, Panama). Jordan, D. S., & Gilbert, C. H., *Bull. U. S. Fish Comm.*, 2, 1882 (1883): 105 (Mazatlan, Mexico).

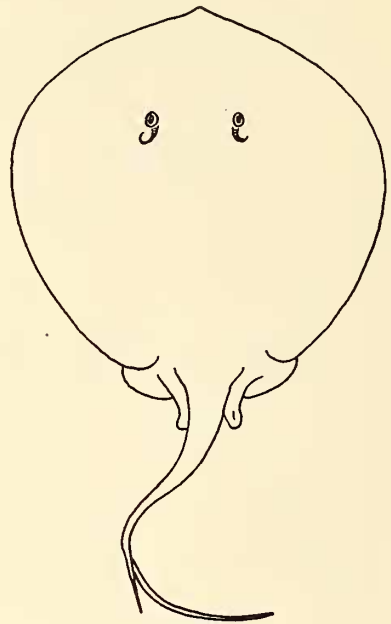
Dasyatis longus, Evermann, B. W., & Jenkins, O. P., *Proc. U. S. Nat. Mus.*, 14, 1892: 132 (notes on 4 specimens, Guaymas, Mexico). Jordan, D. S., *Fishes of Sinaloa*, 1895: 389 (common at Mazatlan).

Dasyatis longa, Gilbert, C. H., & Starks, E. C., *Fishes of Panama Bay*, 1904: 17, 207 (Panama, description). Snodgrass, R. E., & Heller, E., *Proc. Wash. Acad. Sci.*, 6, 1905: 345 (short description; numerous at Narborough Island, Galápagos).

Dasybatus longus, Garman, S., *The Plagiostomia*, 1913: 390, Plate 32, figs. 3, 4 (short description, figure). Meek, S. E., & Hildebrand, S. F., *Marine Fishes of Panama*, 1, 1923: 79 (description, Panama).

Dasyatis pacificus sp. nov.

(Plate II, Figs. 1, 2 and 3).



Text-figure 24.

Type: Holotype, male, No. 26,120, Department of Tropical Research, New York Zoological Society; Port Parker, Costa Rica, January 22, 1938, harpooned at night, total length 1,524 mm. Type in the collection of the American Museum of Natural History.

Field Characters: Tail slender, one and three-quarters times as long as length of disk; two strong caudal spines; no dorsal or caudal fins, but a low keel on the ventral side of the tail; disk sub-spherical with widest area two-fifths of distance back from snout; snout small but protruding beyond disk profile; snout angle blunt, 120 degrees; faint traces of double, dorsal cluster of somewhat enlarged tubercles; entire upper surface a hard armor of solid, low, radiating tubercles. Uniform brown above; white below with a broad border of dark.

Size: The two known specimens measure respectively 1,270 and 1,524 mm. in total length.

Description: Measurements, with percentage of total length (percentages in parentheses). Total length, 1,524 mm., disk length, 558 mm. (35.6); disk width, 622 mm. (41); tail length, 965 mm. (63.3); snout to eye, 132 mm. (8.7); snout to mouth, 110 mm. (7.2); snout to nostril, 90 mm. (5.9); snout to first gill-slit, 190 mm. (12.5); interorbital, 98 mm. (6.45); internarial, 50 (3.3); mouth width, 50 (3.3); eye, 13 mm. (.85);

spiracle, 45 mm. (2.95); interspace of first gill, 146 mm. (9.6); base of tail to first spine, 432 mm. (28.3); first spine length 73 mm. (4.8); second spine length, 135 mm. (8.85); space between base of spines, 50 mm. (3.3); gill-slit greatest length 26 mm.

Whole head and body covered with a mosaic of low, blunt, radiating tubercles. Slight suggestion of two shoulder clusters of slightly enlarged but blunt tubercles. The dorsal tubercles die out toward edge of disk, but become small, sharp spinules along rim of eyes and spiracles, and on distal portion of tail.

The surface of the skin shows a dense covering of separate tubercles. These average 1.4 mm. in diameter, with larger ones up to 2.8 mm. They show no pattern of arrangement, being about their own diameter apart. They are irregularly round, and composed except for a thin basal sheet of bone, of white enamel. From the center radiate four irregular ridges which in turn divide, especially near the margin. The skin between the tubercles is of a very tough, gristle-like character, adding to the tubercles in giving a feeling of solid hardness to the surface as a whole.

A low, infra-caudal keel begins at base of second spine and ends at vertical of tip of spine. Tail, halfway between base and base of first spine, 40 mm. wide, and 27 mm. deep.

Superior velum almost straight, fimbriated. Lower jaw outside, notched in center, thence curving backward on each side to the gape. Considerable area below and behind mouth strongly papillose.

Teeth: Dental area of lower jaw in general wavy, there being three curved depressions in the outer half, the inner half remaining flat and level. Width of this area 43 mm., front to back 15 mm. About 31 rows across, and 12 from front to back. Width of the teeth 1.7 mm. Each tooth has a deep base, stout, extending straight down but not attached to its neighbors. The summit is flat but projects slightly over the two in front, the teeth being staggered like tiles. A deep transverse groove extends across the center of each tooth, and the anterior, or interiorly pointing rim is curved. At the summit of this curve is a well-developed toothlet, almost level with the general surface of the whole area, but pointing down the throat. These small teeth are largest and sharpest among the innermost rows, gradually dying out because of wear as the exterior edge is approached. The edges of each tile tooth, around the central groove is strongly marked with minute ridges and flat cusps.

Five large papillae extend along the bottom of the inside of the mouth, blunt, thick and creased, the largest 8 mm. in height.

Color: Above uniform brown, with considerable dusky mottling on the posterior lobe of the pectorals. Below, creamy white, a border of dusky black beginning as an irregular series of mottlings at snout, and increasing in width and intensity backward to a maximum of 50 mm.,

continued on to the pelvics, and dying out rapidly on the postero-inner border. Claspers dominantly dusky; entire under tail black.

Local Distribution: Our specimens were harpooned in shallow water at night near shore.

Food: In the stomach of one were thirty snapping shrimps, squillas, and a few pieces of broken, strongly ribbed, cardium shells.

Study Material: 2 specimens; Port Parker, Costa Rica; male and female; only one specimen, the type, saved, No. 26,120; total length 1,270 and 1,524 mm.; Jan. 22, 1938; harpooned at night.

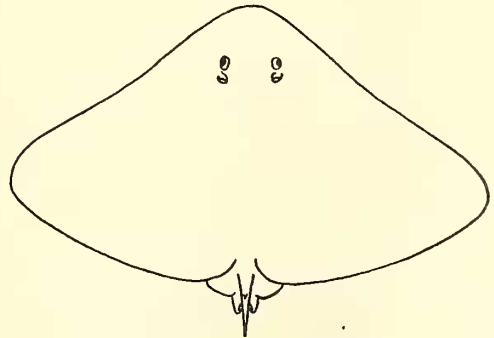
Discussion: The following differences are listed between this new species of *Dasyatus* from the Pacific, and *Dasyatus schmardae* from Jamaica and the Atlantic side of the Panama Canal, which is apparently its closest relative.

In our specimens the spiracles are almost three and a half (3.46) times the length of the eyes (not "more than twice the size of eyes"). The inter-orbital space is 1.24 in preocular snout (not 1.5). The longest gill-slit is 26 mm., twice the length of eye (not "gill-slits small, longest about the length of eye"). Dorsal humeral tubercles are flat and inconspicuous in specimen No. 1, and almost absent in No. 2 (not "two greatly enlarged tubercles or bucklers"). Two large caudal spines in both specimens (not a single caudal spine). Tail is almost round in front of first spine (not "tail notably depressed in advance of spine"). Color white below with wide black border (not "color pale underneath"). Teeth are pale and normally colored (not "teeth very dark"). Disk length into width in our specimens, one and one-tenth and one and one-fifth (not one and one-twentieth).

Notes: Our preparateur ran the spine of one of the rays into his hand, and almost fainted with the pain. It was relieved with hot water and strong epsom salts and after twenty-four hours the pain and swelling were almost gone.

Gymnura Van Hasselt, 1823.

Gymnura marmorata (Cooper).



Text-figure 25.

Range: San Diego to Peru (Mexico: Cedros Island, San Bartolome Bay, Felipe Bay, Gonzago

Bay, San Francisquito Bay, Mazatlan; Panama: Bay of Panama; Peru: Lobos de Afuera).

Field Characters: Disk almost twice as wide as long; tail very short, one-third length of disk; no dorsal or caudal fins, but a slight fold of skin above and below tail; skin perfectly smooth; tail spine very small or absent.

Color: The color and pattern show great variation; typical pattern, disk marked with both light and dark spots on a tan ground darkened by seal-brown dots; the light spots are pale, almost lemon yellow, surrounded by a brown edging; dark spots are vandyke-brown; pelvics are reddish-brown; tail is mottled, sometimes banded.

Size: Reaches a length of between four and five feet.

Abundance: Reported as very common at Mazatlan and elsewhere.

Study Material: None.

References: *Pteroplatea marmorata*, Cooper, J. G., *Proc. Calif. Acad. Sci.*, 3, 1863: 112, fig. 25 (original description, figure, type locality, San Diego, California). Jordan, D. S., & Evermann, B. W., *Fishes North and Middle America*, 1, 1896: 87 (short description, Point Concepcion to Cedros Island). Starks, E. C., & Morris, E. L., *Univ. Calif. Pub. Zool.*, 3, 1907: 173 (description, color, "Santa Barbara to San Bartolome Bay, Lower California"). Osburn, R. C., & Nichols, J. T., *Bull. Amer. Mus. Nat. Hist.*, 35, 1916: 145 (Port San Bartholome, Lower California). Breder, C. M., Jr., *Bull. Bingham Oceanogr. Coll.*, 2, 1928: 12, figs. 11, 12 (questions validity of *P. crebripunctata* Peters and *P. rava* Jordan & Starks, color; Gulf of California: North of San Felipe Bay, San Francisquito, Gonzago Bay, figures). Kumada, T., & Hiyama, Y., *Marine Fish West Coast of Mexico*, 1937: 23, Plate 2 (short description, Plate).

Pteroplatea crebripunctata, Peters, W. C. H., *Monatsber. Akad. Wiss.*, 1869: 703 (original description; Mazatlan, Mexico). Jordan, D. S. & Gilbert, C. H., *Bull. U. S. Fish Comm.*, 2, 1882 (1883): 105 (Mazatlan, Mexico). Jordan, D. S., *Fishes of Sinaloa*, 1895: 390 (description, color, common at Mazatlan, Mexico). Jordan, D. S., & Evermann, B. W., *Fishes of North and Middle America*, 1, 1896: 87 (description, "Gulf of California and southward"), Vol. 3, 1898: 2753 (amended description). Gilbert, C. H., & Starks, E. C., *Fishes of Panama Bay*, 1904: 18 (note on proportions, Panama). Garman, S., *The Plagiostomia*, 1913: 413 (short description, color). Evermann, B. W., & Radcliffe, L., *Bull. U. S. Nat. Mus.*, 95, 1917: 16 (description, color; Peru: Lobos de Afuera).

Pteroplatea rava, Jordan, D. S., & Starks, E. C., in Jordan, D. S., *Fishes of Sinaloa*, 1904: 390 (original description, color, type-locality, Mazatlan, Mexico; type No. 1587, Stanford University Museum). Jordan, D. S., & Evermann, B. W., *Fishes North and Middle America*, 3, 1898: 2754 (copy of original description).

Pteroplatea sp., Kumada, T., & Hiyama, Y., *Marine Fish Pacific Coast Mexico*, 1937: 23, Plate 57 (short description, figure).

Urotrygon Gill, 1863.

Key to species of the tropical eastern Pacific.⁶

- 1a. No enlarged spines or tubercles on the median line of the back; upper surface of the disk closely beset with short prickles, largest on the back.
- 2a. Length of disk about equal to width of disk. *mundus*.
- 2b. Length of disk 1.2 in width of disk. *binghami*.

⁶ This key, adapted and extended from that given by Meek & Hildebrand, (1923), should be used with great caution. The species of eastern tropical Pacific *Urotrygon* are poorly known from a small number of specimens, and in those species where a larger number of specimens have been taken, there is considerable variation. On the Eastern Pacific Expeditions only one specimen of the genus was taken; this helps very little in elucidating the problems of the species of the genus. As an aid to future students we give the original descriptions of each species, plus the references that refer to the eastern tropical Pacific.

1b. One to 8, or a continuous series of spines, on the median line of the back and the base of the tail (wanting in very young); skin smooth or less prickly.

3a. A *continuous* series of spines on the median line of the back, extending from shoulder to caudal spine; skin with short prickles. *asterias*.

3b. No *continuous* series of spines on the median line of the back; spines sometimes present in a group on the middle of the back, or on the tail.

4a. One to three strong spines on the middle of the back.

5a. Spines present on the tail immediately before the caudal fin. *chilensis*.

5b. No spines on the tail before the caudal fin. *goodei*.

4b. No sharp spines on middle of back; one to 9 sharp spines at base of tail in advance of caudal spine; skin smooth. . . *aspidurus*.

Urotrygon aspidurus (Jordan & Gilbert).

Range: Panama Bay.

Copy of original description: "Color plain brown; upper side of body and tail white.

"Disk very slightly longer than broad, its length very little less than length of tail; anterior margins of disk nearly straight, the anterior tip abruptly projecting as an exerted, narrow, triangular prominence rounded at its end; length of exerted part about as long as the width of its base, and from half to two-thirds the interorbital width, it being longer and sharper in a male specimen, in which also the anterior margins of the disk form a less obtuse angle; distance from eye to tip of snout about one-third length of the disk. Eyes very small, much smaller than the large spiracles, their diameter less than half interorbital width. Width of mouth $2\frac{1}{2}$ in distance to tip of snout. Nostrils directly in front of mouth; nasal folds forming a broad continuous flap, the edges of which are slightly fringed. Ventrals projecting a little beyond outline of disk. Caudal spine very large, its length a little more than twice interorbital width (in a large female specimen duplicated, and as long as from eye to tip of snout), its insertion well in front of middle of tail. Caudal fin long and low, the lower portion longer, beginning nearly opposite tip of caudal spine. Depth of tail with the caudal fin, about half interorbital width.

"Skin entirely smooth, with the exception of a series of strong broad-rooted spines or bucklers on the upper part of the tail in front of caudal spine, and sometimes a series of minute sand-like prickles on snout, and on median line of body. These latter are present only in a large female specimen, which also has 8 spines on the tail instead of 2 as in the others. These spines are straight, sharp, directed backwards, their height about equal to width of base which is somewhat longer than diameter of pupil.

"This species is not uncommon in the Bay of Panama, and is brought into the market in company with *Urolophus mundus*. Three speci-

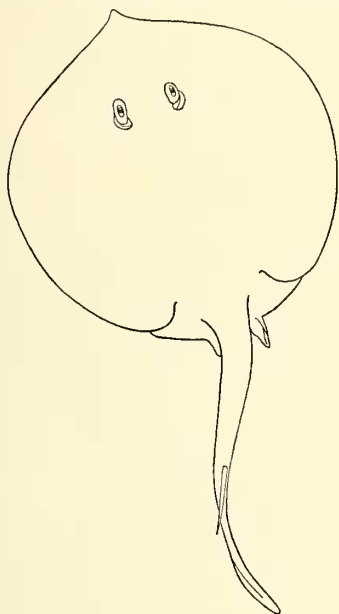
mens were obtained, the largest about 18 inches in length."

Gilbert & Starks (1904, p. 16) made corrections and additions to this description and described embryos, and Garman (1913, p. 405) speaks of the relationship of *U. chilensis* to this species.

References: *Urolophus aspidurus*, Jordan, D. S., & Gilbert, C. H., *Bull. U. S. Fish Comm.*, 1, 1881 (1882): 306, 307 (original description, type locality, Panama Bay). Gilbert, C. H., & Starks, E. C., *Fishes of Panama Bay*, 1904: 16 (description, adult and embryos, Panama Bay, abundance). Garman, S., *Bull. Mus. Comp. Zool.*, 46 (12) 1906: 229 (Panama). Kendall, W. C., & Radcliffe, L., *Mem. Mus. Comp. Zool.*, 35 (3) 1912: 80 (Panama Bay).

Urotrygon aspidurus, Garman, S., *The Plagiostomia*, 1913: 405, Pl. 69 (numerous specimens, Panama; "Hardly to be separated from *U. chilensis* Günther, 1871," figure of skeletal cartilages).

Urotrygon asterias (Jordan & Gilbert).



Text-figure 26.

Range: Mexico and Panama. (Mexico: Mazatlan, Acapulco, and "west coast of Mexico"; Panama: Bahia Honda, Naos Island, Panama Bay.) (Illustration after figure of *U. mundus*, Garman, 1913, 210 mm.)

Copy of original description of U. asterias: "Disk almost round, a little broader than long; its length just about equal to length of tail. Anterior margins of disk nearly straight, the tip acute, slightly exserted, much less prominent than in *U. aspidurus*, longer in the male specimen than in the females. Distance from eye to tip of snout, about one-fourth length of disk and a little more than twice interorbital width. Interorbital space somewhat concave. Eyes small, much smaller than the large spiracles, the diameter about half the interorbital width. Width of mouth $2\frac{1}{6}$ in distance from tip of snout. Teeth conic and sharp in the males, blunter and somewhat pavement-like in the females. Nostrils

directly in front of angles of mouth; nasal folds forming a broad continuous flap, the edges of which are slightly fringed.

"Ventrols projecting a little beyond outline of disk. Caudal spine very long, somewhat longer than snout, its insertion considerably in front of middle of tail. Caudal fin moderate, the upper lobe deepest, inserted opposite tip of caudal spine, the lower lobe beginning farther forward, the depth of the tail with caudal fin, about half the interorbital space.

"Skin above everywhere rather sparsely covered with small stellate prickles, these larger and more numerous toward the median line of the back and head; wanting on the ventral fin. Males and females about equally rough. Median line of back with strong, sharp recurved spines, 18 to 32 in number, extending from the shoulders to the front of the caudal spine, these usually becoming much larger and sharper backward, but the largest much smaller than the spines in *U. aspidurus*.

"Color, light brown, without distinct markings; tail, faintly edged with dusky; lower side white.

"This species is not rare at Mazatlan, where it is known as *Raia*. It is also occasionally taken at Panama.

"Three females and one male specimen, from 12 to 16 inches in length, were brought from Mazatlan, and one young male from Panama."

Copy of original description of Urotrygon rogersi: "Disk broader than long by a distance two and a half times the interorbital width; anterior margins of disk nearly straight, the tip of snout projecting; snout from eye three and three-quarters in length of disk; eyes little smaller than spiracles; width of mouth two and a half times in preoral part of snout; caudal spine inserted in front of middle of tail. Skin with minute prickles on margin of pectorals and on middle of back, leaving smooth areas near middle of pectorals and over branchial arches; 16 to 20 large spinules along median line of back and tail. Color, plain brown; caudal fin darker, edged with white.

"This species differs from *Urolophus asterias* in having a wider disk, more acute snout, much smaller prickles, and fewer spinules on back and tail.

"Three specimens obtained in the Astillero (Mazatlan), the longest is 18 inches in entire length."

Concerning this type which is in the collection of Stanford University, Dr. G. S. Myers writes as follows:

"The holotype of *Urolophus rogersi* is a female with the following present dimensions; total length 430 mm.; width of disk 280; snout tip to end of pelvic 238; tail length from anus 220; interocular 28; snout, left orbit to tip 68; between lower angles naso-labial flaps 25 mm."

The single small specimen of *Urotrygon* in our collection seems to fit best in this species.

Study Material: 1 specimen; seven miles west of Champerico, Guatemala; Station 197:D-2, 14 fathoms, Dec. 15, 1937, male, total length 148 mm., Cat. No. 27,520.

Disk almost circular, anterior margins straight, snout considerably produced; tail from base to spine strongly depressed; claspers developed well beyond pelvics; disk above generally but rather sparsely covered with very fine, sharp spines, especially abundant near, and actually along edge of anterior margins (except along extreme snout), on head and around eyes; these spines are almost absent from mid-back area, of mid-disk to tail; a series of low, blunt spinules, just visible above skin, from base of tail to spine, with numerous small spines down sides of tail, and generally over dorsal surface; dorsal portion of caudal fin with two lateral rows of spinules, and an irregular row near and along dorsal edge; ventral portion of caudal fin smooth; disk below smooth, but marginal spines visible. Caudal spine long and slender; the tip for an extent of 2 mm. is smooth; this is followed by about 18 strong, sharp barbs, extending for half the total length of the spine. Teeth in about twenty transverse rows, each with a wide, transverse base, and a tall, slightly tapering, stout cusp, curved slightly backward; two small, reserve teeth lying obliquely at the posterior base of each erect tooth. Anterior oral velum with about thirty-five papillae. Eyes very small, black.

Measurements: Percentages in total length; total length, 148 mm., disk length, 75 mm. (50.7); disk width 83 mm. (56); tail length, 80 mm. (54); base of tail to spine, 30 mm. (20.2); snout to eye, 26 mm. (17.6); snout to mouth 22 mm. (14.9); snout to nostril, 18 mm. (12.2); snout to 1st gill, 35 mm. (23.6); interorbital, 11 mm. (7.4); internarial, 10 mm. (6.75); mouth width, 9 mm. (6); eye, 2 mm. (1.35); spiracle, 2.9 mm. (1.95); interspace of 1st gills, 21 mm. (14); interspace of 5th gills, 18 mm. (12.2); spine length, 29.3 mm. (19.7). Teeth: base width .43; cusp height .23; height whole tooth .3 mm. Tail: half way between base and spine, 7 mm. wide and 4.4 mm. deep.

Color: Uniform dark buffy-brown above; white below.

References: *Urolophus asterias*, Jordan, D. S., & Gilbert, C. H., *Proc. U. S. Nat. Mus.*, 5, 1882 (1883): 579 (original description, Mazatlan and Panama). Jordan, D. S., *Fishes of Sinaloa*, 1895: 388 (Mazatlan, Mexico, very common). Kumada, T., & Hiyama, Y., *Marine Fish West Coast Mexico*, 1937: 22, Plate 56 (brief description, figure).

Urotrygon asterias, Meek, S. E., & Hildebrand, S. F., *Marine Fishes of Panama*, 1, 1923: 83 (description of adults and embryos, discussion). Breder, C. M., *Bull. Bingham Oceanogr. Coll.*, 2 (1), 1928: 11, fig. 8 (Bahia Honda, Panama; figure).

Urolophus mundus, Gilbert, C. H., & Starks, E. C., *Fishes of Panama Bay*, 1904: 16 (Panama; not of Gill).

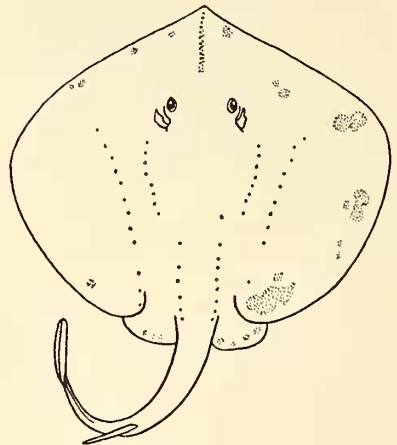
Urotrygon mundus, Garman, S., *The Plagiostomia*, 1913: 406, Plate 30, figs. 1, 2 (in part).

Urolophus rogersi, Jordan, D. S., & Starks, E. C., in Jordan, D. S., *Fishes of Sinaloa*, 1895: 388 (original description; type locality Mazatlan, Mexico; type No. 1700, Stanford University Museum). Kendall, W. C., & Radcliffe, L., *Mem. Mus. Comp. Zool.*, 35, 1912: 80 (short description, Acapulco, Mexico).

Urolophus sp., Kumada, T., & Hiyama, Y., *Marine Fish Pacific Coast of Mexico*, 1937: 22, Plate 56, fig. B. (figure).

Discussion: The figure of Kumada & Hiyama is included in the species principally because of the statement in Meek & Hildebrand (1923: 83) that the "wing-like expansion is proportionately greater in the adult than in the young."

Urotrygon binghami Breder.



Text-figure 27.

Range: Mouth of Colorado River, Gulf of California, in 10–14 fathoms.

Copy of original description of Urotrygon binghami: "Type No. 1019 Bingham Oceanographic Collection. Total length 190 mm.

"Disk somewhat angular; broader than long, length 1.2 in breadth; the anteriolateral margins slightly convex to directly in front of eyes where they become concave to meet at the rather produced tip of snout; the posterior-lateral margins strongly convex; interorbital space 2.2 in preocular part of snout; spiracles a little larger than eyes and placed immediately behind them; mouth slightly curved, 2.7 in preocular part of snout; teeth pointed, small, diamond shaped; tail somewhat shorter than disk, 1.2 in disk; caudal fin low and long, pinnaform, extending on tail, 2.7 measured from tip to vent; spine inserted a little more than an eye's diameter nearer to vent than to tip of tail; tail strongly depressed, but with no lateral keels; ventral fins broad, with posterior margins continuing curve of pectorals; skin smooth, no distinct prickles anywhere but with small light points that suggest the possible development of them at a greater size. See Figures 6 and 7.

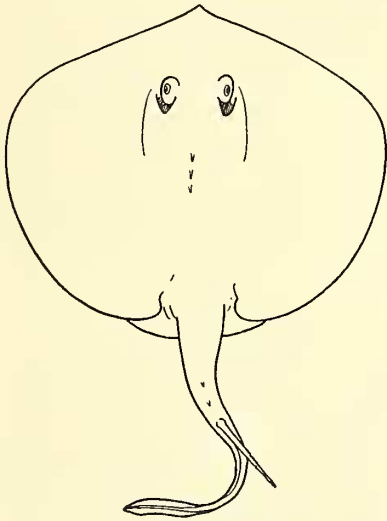
"Coloration—Nearly uniform grayish tan above, light below with numerous sub-dermal dark splotches. Caudal fin dusky, edged with light. There are a few light dots on snout and wings and a few dark blotches irregularly placed.

"This form is closest to *U. mundus* Gill but differs prominently in the much broader disk, the shorter tail, the more prominent snout, the curve of the ventrals and in other minor details. It

also differs from *U. mundus* in the lack of prickles, which, however, it may develop at greater size and from *U. asterias* (Jordan & Gilbert) in the lack of a median row of spines which would surely be evident at this size." (Illustration after Breder, 1928, 190 mm.)

References: *Urotrygon binghami*, Breder, C. M., Jr., *Bull. Bingham Oceanogr. Coll.* 2 (1), 1938: 11, figs. 6, 7 (original description, figures; type-locality, between San Felipe and Shoal Point, Rio Colorado; type No. 1019, Bingham Oceanogr. Coll., Yale University).

Urotrygon chilensis (Günther).



Text-figure 28.

Range: Chile (extralimital).

Copy of original description: "Disk broader than long; snout a little projecting; tail longer than the disk. Disk smooth, but with spines along the median line, viz., three in a single series in the middle of the back, and two on the tail, in front of the serrated spine. No rudimentary dorsal fin. Upper parts nearly uniform brownish, with a few very indistinct darker specks.

"Distance of the extremity of the snout from the vent— $4\frac{1}{2}$ inches.

"Distance of the extremity of the tail from the vent— $5\frac{3}{4}$ inches.

"Greatest width of the disk— $6\frac{1}{2}$ inches.

"One example from the Geoffroy Museum, is in the collection of the British Museum."

The description by Garman (*Plagiostomia*, 1913: 405) is practically identical with the above. He adds however, "Günther's figure so closely represents the species later described as *U. aspidurus*, differing mainly in the anterior position of some of the tubercles, as to raise doubt of the validity of that species." (Illustration after Günther, 1871, 255 mm.)

Reference: *Urolophus chilensis*, Günther, A., *Proc. Zool. Soc. London*, 1871: 653, Plate 53 (original description, figure, type-locality, Chile).

Urotrygon chilensis, Garman, S., *The Plagiostomia*, 1913: 405 (description; possibility of *U. aspidurus* being the same as *chilensis*).

This description of this extralimital species is included because of Garman's note as to its relationship to *aspidurus*.

Urotrygon goodiei (Jordan & Bollman).

Range: Panama and Ecuador. (Panama: 10 miles S. of Pearl Islands; Ecuador: St. Helene Bay).

Copy of original description: "Diagnosis.—Approaching *Urolophus halleri* and *nebulosus*, from which it is separated by the presence of a strong spine on the middle of the back, by the more angular outline, the narrow ventrals, and the plain coloration.

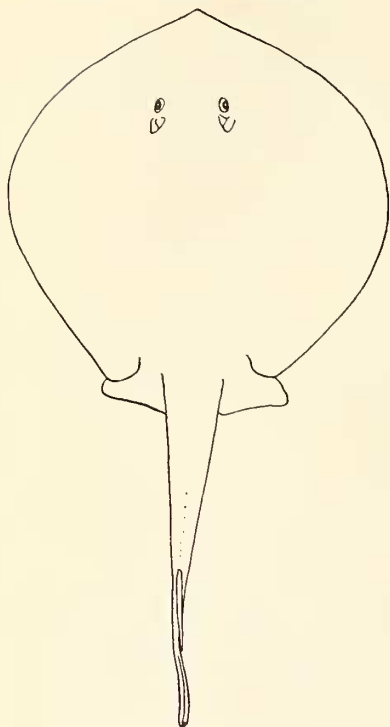
"Type: No. 41,150, U. S. National Museum.

"Hab.—Pacific Ocean, off coast of Colombia: $8^{\circ} 06' N.$, $78^{\circ} 51' W.$

"Description.—Disk (to posterior base of pectorals) broader than long by a distance equal to snout and half eye; anterior margins of disk very slightly convex from in front of eyes outwards. Snout with its tip exerted and sharply pointed, its length $3\frac{3}{4}$ in disk to base of pectorals. Eye about equal to spiracle, $3\frac{1}{4}$ in snout. Margin of spiracles not denticulated. Interorbital area scarcely concave, its width 2 in snout. Width of mouth 2 in preoral part of head. Nasal fold concave behind, its edge fringed. Ventrals projecting considerably beyond disk, their length (from anterior margin of vent backwards) $1\frac{1}{4}$ in their breadth. Caudal spine large, its length equal to snout and half eye, its margin with 8–10 sharp forward-projecting spinules; its insertion anterior to middle of tail measured from pectorals, its tip reaching front of caudal. Caudal fin (measured from end of spine) equal to snout and eye. Length of tail greater than that of disk by a distance equal to eye and spiracle. Body (in young specimens) entirely smooth except for the presence of one (or two) sharp spine on middle of back. Color plain brown, paler toward margins of disk; no spots or distinct markings; under side not mottled; caudal dark above, margined with pale.

"The above description was taken from a young female specimen 7 inches long. This specimen has the snout wholly smooth. Another, about an inch shorter has two spines on middle of back and the snout prickly. Both specimens were dredged at Station 2795, with the preceding species. The snout is wholly smooth in the type."

References: *Urolophus goodiei*, Jordan, D. S., & Bollman, C. H., *Proc. U. S. Nat. Mus.*, 12, 1889 (1890): 151 (original description, type locality, Albatross station 2795, $8^{\circ} 06' 30'' N.$, $78^{\circ} 51' W.$, 10 miles south of Pearl Islands, Bay of Panama, in 33 fathoms; type No. 41,150, U. S. Nat. Mus.). Boulenger, G. A., *Boll. Mus. Univ. Torino*, 13, 1898: 1 (St. Helene Bay, Ecuador).

Urotrygon mundus Gill.

Text-figure 29.

Range: Mexico, Costa Rica, Panama. (Mexico: Port San Bartholome, Estaban Island; Costa Rica: Puntarenas; Panama: Panama.)

Copy of original description: "The disk is orbicular with a slight linguiform projection in front and with the pectoral fins behind broadly rounded. The distance of the snout from the hinder margin of the pectorals equals the width of the disk. The tail (behind the anus) is rather longer than the body (in front). The spine is inserted behind the middle of the tail, and is about as long as the distance between the snout and the nostrils. The ventral fins extend outwards, the rectilinear anterior margin tending little backwards, and the external margins are on a line with and complete the outline of the disk. The posterior margin in the male is nearly rectilinear, while in the female it is slightly convex, especially towards the inner angles. The upper velum is very sinuous and fimbriated. The teeth are pointed and pyramidal. The spiracles are oval, interrupted at the intero-anterior angle by the eyes, and the margins are entire and well defined. The skin is beset with numerous, small, stelliform tubercles, larger on the dorsal region. The color is a uniform dark brown above.

"Two small specimens, male and female, are in the collection.

"The present species would, by many zoolo-

gists, be referred to the genus *Urolophus* of Muller and Henle, but it would appear that it and the *U. torpedinus* should be separated from that genus and referred to a distinct one, distinguished by the rounded and not angular outline, the longer tail and posterior insertion of the spine, and especially the acute teeth." (Illustration after Meek & Hildebrand, 1923, 220 mm.)

U. asterias and *U. rogersi* have been synonymized under this species. Meek & Hildebrand, however, give evidence to show that *asterias* and *mundus* are distinct.

References: *Urotrygon mundus*, Gill, T., *Proc. Acad. Nat. Sci. Phila.*, 1863: 173 (original description; type locality Panama; type lost). Garman, S., *The Plagiostomia*, 1913: 406, Plate 30 (in part; plate). Osburn, R. C., & Nichols, J. T., *Bull. Amer. Mus. Nat. Hist.*, 35, 1916: 145 (Lower California; Port San Bartholome, Estaban Island). Fowler, H. W., *Copeia*, 39, 1917: 3 (Costa Rica: Puntarenas). Meek, S. E., & Hildebrand, S. F., *Marine Fishes of Panama*, 1, 1923: 82, Plate 4 (description, color, figure; not identical with *asterias*).

Urolophus mundus, Jordan, D. S., & Evermann, B. W., *Fishes North and Middle America*, 1, 1896: (short description). Jordan, D. S., & Evermann, B. W., *Fishes North and Middle America*, 3, 1898: 2752 (statement that *mundus* and *asterias* are identical). Gilbert, C. H., & Starks, E. C., *Fishes of Panama Bay*, 1904: 16 (comments on identity of *asterias*, *mundus* and *rogersi*; see under *asterias*).

Urobatis Garman, 1913.

Key to tropical eastern Pacific species.

- 1a. Ashy gray, or brown, spotted conspicuously with black or dark brown *maculata*.
- 1b. Brown in general color, not spotted with black.
 - 2a. Brown with large pale spots, the darker interspaces forming reticulations, two narrow pale bands around the whole disk. *concentricus*.
 - 2b. Plain brown, or with yellow dots and vertical lines, no pale lines around the disk. *halleri*.

Urobatis concentricus Osburn & Nichols.

Reticulated Round Ray.

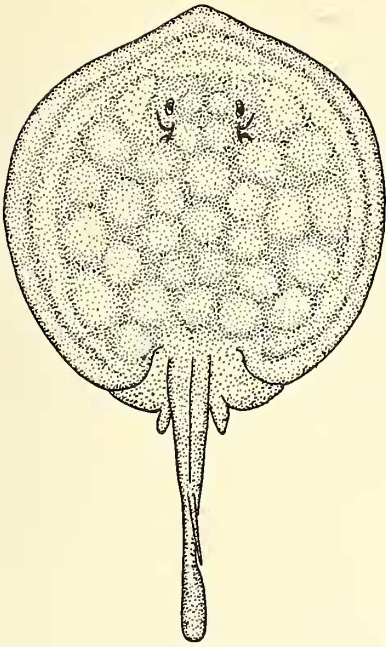
(Plate III, Fig. 2).

Range: Gulf of California south to southern Mexico. (Mexico: San Estaban Island, Inez Bay, San Lucas Bay, Port Guatulco.)

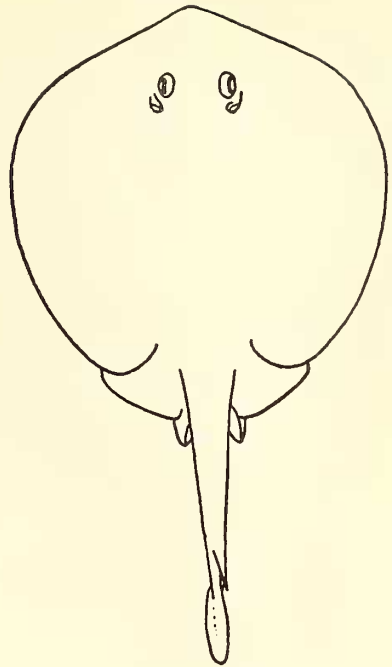
Field Characters: Disk outline round; no dorsal fins but a well-developed caudal fin; skin smooth; a strong caudal spine; tail shorter than disk; color dark, with large, rounded, pale spots, and with two pale lines bordering the disk. (Illustration from specimen No. 26,142, 385 mm.)

Color: The ground color is dark brown, broken everywhere into coarse reticulations by large, rounded, pale spots. They are arranged in two or three irregular rows around the mid-line of the disk, but they are different in each individual. Two, narrow, pale, unbroken bands, concentric with these spots, surround the outer area of the entire disk and extend on to the pelvis. Under side pale.

Size: The largest ray thus far recorded is a male taken by us at Inez Bay, with a total length of 475 mm.



Text-figure 30.



Text-figure 31.

Local Distribution: All our specimens were speared at night in shallow water.

Abundance: In Inez Bay we found these the most abundant of the smaller rays.

Food: Three individuals taken at Inez Bay had been feeding exclusively on small crabs. Two others had eaten polychaete worms.

Breeding: The females, measuring from 325 to 400 mm., had fully developed ovaries but no signs of eggs or young.

Study Material: 13 specimens; Mexico, Inez Bay, 11, 6 males, 5 females (24,999) 204 to 475 mm., April 13 to 16, 1936, speared at night. San Lucas Bay, female, (not saved) 460 mm. April 23, 1936, speared at night. Port Guatulco, female (26,042, Photo. 8537) 385 mm., Dec. 3, 1937, speared at night.

References: *Urobatis concentricus*, Osburn, R. C., & Nichols, J. T., *Bull. Amer. Mus. Nat. Hist.*, 35, 1916: 144, fig. 2 (original description, color; type locality San Esteban Island, figure, type No. 5199, Amer. Mus. Nat. Hist.).

Discussion: The only other recorded specimens are the type and three other individuals taken by the *Albatross*, at Esteban Island, in the Gulf of California on April 13, 1911. They were all males, and measured from 369 to 432 mm.

Urobatis halleri (Cooper).

Little Round Sting Ray.

Range: San Diego to Panama Bay (Mexico: Todos Santos Bay, San Francisquito Bay, Mazatlan, Colima, Acapulco; Panama: Panama Bay).

Field Characters: Disk outline round; no dorsal fins but a well-developed caudal fin; skin smooth; strong spine; tail shorter than disk; total length twenty inches or less. Color plain dark brown, or with numerous minute dots, or in female with a few dark spots. (Illustration after Starks, 1918.)

Color: Variations in a lot of one hundred specimens; "Most are brown with small spots of yellow, very small on some, larger on others, smaller toward the margins, thickly strewn over the entire back and tail. Less common variation are the brown ones with the yellow in the form of vermiculations. Some are more yellow than brown." (Garman, 1913.)

Size: The largest ray recorded is 521 mm. in length.

Local Distribution: These rays are found lying on the bottom, nearly buried in loose sand or mud.

Abundance: In places the shallow waters are said to be almost lined with these small rays, which are very dangerous to fishermen.

Food: Said to scoop out large holes in mud banks by waving the pectoral fins, eating the worms, crabs and small fishes thus exposed.

Breeding: Ovoviviparous; mating taking place in April, and the young, one to eight in number, are born in late July or August. Starks & Morris say that two embryos, nearly three inches long, taken from the oviduct, have a conspicuous flap extending back from the eye and upper edge of spiracle, and ending in a long, free point behind.

Study Material: None.

References: *Urolophus halleri*, Cooper, J. G., *Proc. Cal. Acad. Sci.*, 3, 1863: 95 (original description, San Diego, California). Jordan, D. S., & Gilbert, C. H., *Bull. U. S. Fish Comm.*, 2, 1882: 105 (Mazatlan, Mexico). Jordan, D. S., & Gilbert, C. H., *Proc. U. S. Nat. Mus.*, 5, 1882 (1883): 621 (Panama). Jordan, D. S., & Evermann, B. W., *Fishes North and Middle America*, 1, 1896: 80 (short description, color). Gilbert, C. H., & Starks, E. C., *Fishes of Panama Bay*, 1904: 15 (notes). Starks, E. C., & Morris, E. L., *Univ. Calif. Publ. Zool.*, 3 (11) 1907: 172 (color, embryos). Wilson, C. B., *Proc. U. S. Nat. Mus.*, 35, 1909: 447, 448 (copepod parasite). Kendall, W. C., & Radcliffe, L., *Mem. Mus. Comp. Zool.*, 35 (3) 1912: 80 (Acapulco, Mexico). Wilson, C. B., *Proc. U. S. Nat. Mus.*, 64 (17) 1925: 11 (parasitic copepod). Kumada, T., & Hiyama, Y., *Marine Fish Pacific Coast Mexico*, 1937: 22, Plate 55, fig. A. (short description, part, figures of female only).

Urolophus nebulosus, Garman, S., *Proc. U. S. Nat. Mus.*, 8, 1885 (1886): 41 (original description, comparison with *halleri*; Colima, Mexico, type No. 7356, U. S. Nat. Mus.). Evermann, B. W., & Jenkins, O. P., *Proc. U. S. Nat. Mus.*, 14, 1891 (1892): 132 (similarity to *halleri*, color, embryos, measurements, Guaymas, Mexico); Jordan, D. S., & Evermann, B. W., *Fish North and Middle America*, 1, 1896: (description, "replacing *halleri* southward"); Gilbert, C. H., & Starks, E. C., *Fishes of Panama Bay*, 1904: 15 (no authentic record for Panama).

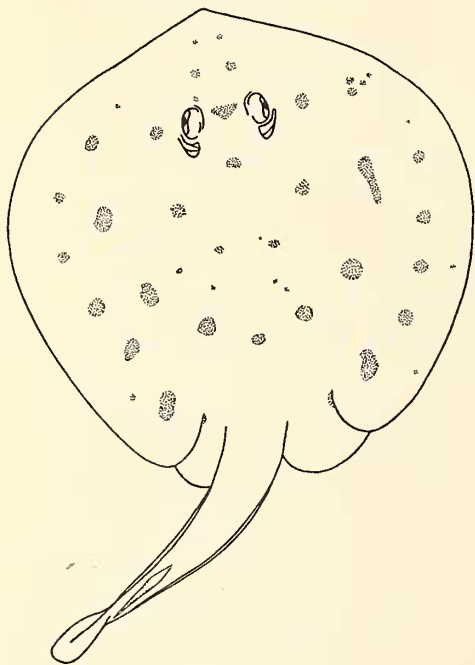
Urolophus halleri, Garman, S., *The Plagiostomia*, 1913: 403 (description, color variation in one hundred specimens). Meek, S. E., & Hildebrand, S. F., *Marine Fishes of Panama*, 1, 1923: 86 (comment on absence of recent Panama records, copy of Jordan & Evermann des., and of Garman's comments on color). Breder, C. M., Jr., *Bull. Bingham Oceanogr. Coll.*, 2 (1) 1928: 12, fig. 10 (San Francisquito Bay, Gulf of California; figures). Barnhart, P. S., *Marine Fish So. Calif.*, 1936: 14, fig. 38 (ecological notes, figure).

Urolophus umbrijer, Jordan, D. S., & Starks, E. C., in Jordan, D. S., *Fishes of Sinaloa*, 1895: 389 (original description; Mazatlan, Mexico).

Urolophus nebulosus, Garman, S., *The Plagiostomia*, 1913: 403 (short description).

Urolophus maculatus Garman.

Spotted Round Sting Ray.



Text-figure 32.

Range: Gulf of California (Mexico: San Felipe Bay, Gonzago Bay, San Francisquito Bay, Inez Bay).

Field Characters: Disk outline round; no dorsal fins, but a well-developed caudal fin; skin smooth; a strong caudal spine; tail shorter than disk; color, light brown with fifteen to thirty small, round, black spots scattered over disk, all smaller than eye. (Illustration from specimen No. 25,265, 247 mm.)

Color: Light brown or ashy gray with many small dots of black, chiefly marking the openings of the lateral line system tubules; also a series of small dots along the sides of the tail, and on for a short distance along the disk; in some specimens a series of dots forming triangles along the inner edge of the pectorals. The dominant pattern is formed by a scattering of fifteen to thirty larger spots of black, all smaller than the eye, arranged in about three concentric lines around the disk, or so irregularly that this pattern is lost; below, creamy white.

The colors of a fresh specimen, a male, 400 mm. long, as sketched by an artist, are given by Breder as follows: "The disk is edged by a reddish brown becoming lighter posteriorly and deepening anteriorly to a chocolate on the entering angle. Inside of this and parallel to the edge runs a broken vandyke-brown band, darkest and widest across the snout. The central part of the disk is lighter and variously mottled with light tan, pale slate, and greenish-brown. The claspers are purplish and the caudal base anterior to the spine, is similarly suffused. Posterior to the spine and on the fin proper there is a slightly bluish cast. Below, the central part of the disk is a very pale tan and a faint olive tint."

Size: The largest ray of this species measured 420 mm. in length.

Dimensions: (in percentage of total length).

	Male 24,997	Female 25,265	Female 25,265a
Total length.....	272 mm.	247 mm.	270 mm.
Disk length.....	55%	59.5%	54.5%
Disk width.....	58	58.7	55.6
Tail length.....	46.5	50	45.6
Snout to mouth.....	12.5	12	12
Snout to eye.....	14.7	13.8	11
Snout to nostril.....	10.2	9.7	9.25
Snout to end of pelvics...	63.5	62	61
Snout to 1st gill-slit.....	22.4	21.9	21
Interorbital.....	5.9	5.7	5.5
Internarial.....	5.9	6	5.2
Mouth width.....	6.6	6.5	6.3
Space between 1st gill-slits	14.3	11.3	14
Space between 5th gill-slits	9.2	8	9

Food: Six individuals had been feeding on large polychaete worms, *Leodice* sp., and a scattering of amphipods.

Study Material: 4 specimens. Mexico: Santa Inez Bay, two males, two females (24,997, 25,265, 25,265a), length 242 to 276 mm., April 13 to 16, 1936. Spared at night.

References: *Urolophus maculatus*, Garman, S., *The Plagiostomia*, 1913: 404 (original description, Gulf of California). Breder, C. M., Jr., *Bull. Bingham Oceanogr. Coll.*, 2 (1) 1928: 12 (color; San Felipe Bay, Gonzago Bay, San Francisquito Bay); Beebe, W., "Zaca Venture", 1938: 120, 300 (Santa Inez Bay, Gulf of California). *Urolophus halleri*, Kumada, T., & Hiyama, Y., *Marine Fish West Coast Mexico*, 1937: 22, part; Plate 55, fig. B (description, in part, figure).

Discussion: Kumada & Hiyama's figure of the supposed male of *U. halleri* is identical with a male in our collection here assigned to *maculatus*. We have similarly patterned males and females of *maculatus*.

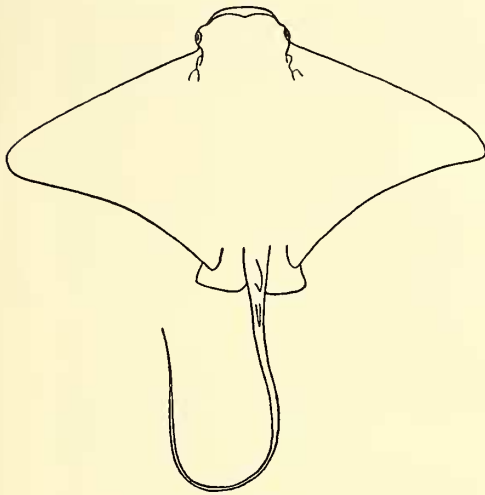
Family AETOBATIDAE.

Key to tropical eastern Pacific genera.

- 1a. Teeth pavement-like, forming a flattened plate; more than three rows in each jaw, the central row much wider than the others.
- 2a. Side of head not free from the pectoral fins; upper surface of body and wings uniformly colored, without spots or bands. *Aetobatis*.
- 2b. Sides of the head free from the pectoral fins; upper surface of body and fins with white bands and spots. *Pteromyllaeus*.
- 1b. Teeth pavement-like, forming a flattened plate; in a single row in each jaw; upper surface of body with white spots. *Stoasodon*.

Aetobatus Blainville, 1816.⁷

Aetobatus californicus (Gill).



Text-figure 33.

Range: Cape San Mendocino, California, south to Magdalena Bay, Lower California (Mexico: Port San Bartholome, Turtle Bay, Santa Maria Bay).

Field Characters: Large rays with pointed pectoral fins; tail whip-like without a caudal fin; a single dorsal fin in front of the caudal spine; spine often duplicated; a fleshy flap around the front of the head formed by the joined "cephalic fins"; teeth large and flat, pavement-like, a row

⁷ We are unable to supply a key to differentiate the two forms of *Aetobatus* recorded here. A review of the illustrations of the Californian species demonstrates that Garman's key is useless, while the isolation of the species, over two thousand miles between the ranges of the two, demands that the two forms be maintained as separate species until proved otherwise.

of large teeth in the center with rows of smaller ones at the side. Dark brown, bronzed or greenish; lower surfaces white, darker toward the tips of the fins. (Illustration after Walford, 1935.)

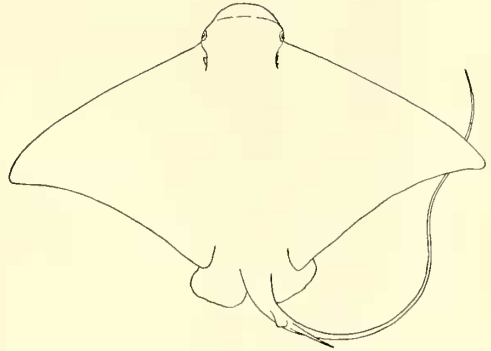
Size: Grows to about 4 feet wide and to a weight of 150 pounds.

Study Material: None.

References: *Rhinoptera vespertilio*, Girard, C. F., *Proc. Acad. Nat. Sci. Phila.*, 8, 1856: 137 (Tomales Bay, California; not *Myliobatis vespertilio* Bleeker).

Myliobatis californicus, Gill, T. N., *Ann. Lyc. Nat. Hist., New York*, 8, 1865: 137, after Girard, Osburn, R. C., & Nichols, J. T., *Bull. Amer. Mus. Nat. Hist.*, 35, 1916: 145 (Mexico: Port San Bartholome, several specimens; Santa Maria Bay, one specimen). Wales, J. H., *Copeia*, 1932: 163 (Mexico: Turtle Bay, 5 seined). Walford, L. A., *Div. Fish and Game, California, Fish Bull.*, 28, 1931: 40, fig. 18 (diagnosis, notes, figure, grows to 4 feet). Walford, L. A., *ibid.*, 45, 1935: 61, fig. 56 (diagnosis, general notes, figure attains a weight of 150 pounds). Barnhart, P. S., *Marine Fishes of Southern California*, 1936: 14, fig. 39 (short description, range, figure).

Aetobatus peruvianus (Garman).⁸



Text-figure 34.

Range: Peru (Paita, Callao).

Field Characters: Similar to those of *A. californicus*. (Illustration after Garman, 1913, 600 mm.)

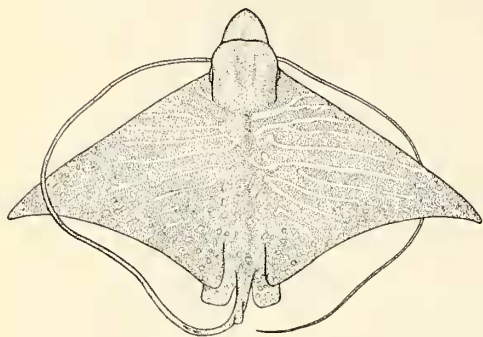
Size: The largest recorded specimen is 26 inches across the disk.

Study Material: None.

References: *Myliobatis peruvianus*, Garman, S., *The Plagiostomia*, 1913: 430, Plate 36, fig. 4-6, Plate 55, fig. 8, Plate 73, fig. 2 (original description: type locality, evidently Peru by the specific name; figure of entire fish, head from below, teeth, anterior skeleton; type in Mus. Comp. Zool. ?).

Myliobatis californicus, not of Gill. Evermann, B. W., & Radcliffe, L., *Bull. U. S. Nat. Mus.*, 95, 1917: 17 (Peru; Paita and Callao; short description of 580 mm. and 715 mm. fishes, color). Abbott, J. F., *Proc. Acad. Nat. Sci. Phila.*, 1899: 331 (local name, few measurements of a specimen from Callao, Peru. Range stated as "Cape Mendocino, San Diego, Callao").

⁸ More than 2000 miles separate the range of this form from that of *californicus*. It is evident that no idea can be obtained from the literature as to the relationships of these two forms. Such characters as were used by Garman (1913: 428) for the differentiation of the Pacific forms, fail to adequately distinguish them. This is especially evident when illustrations of *californicus* such as those given by Walford and Barnhart are studied, and compared with Garman's description and keys.

Pteromylaeus Garman, 1913.*Pteromylaeus asperrimus* (Gilbert).

Text-figure 35.

Range: Panama Bay.

Field Characters: A large ray with wide, pointed wings, projecting snout; sides of the head free from the pectoral fins; teeth in more than three rows in each jaw; tail whip-like with a spine near the base. Upper surfaces brownish; anterior part of the body and fins with narrow transverse bars of bluish-white which break up into a series of spots toward the outer margins of the fins, the posterior bars also breaking up into spots towards the mid-line of the body, posterior edge of wing with bluish white spots. (Illustration after Gilbert & Starks, 1904, width of disk 345 mm.)

Size: Grows to a width of 790 mm. across the wings.

Study Material: None.

References: *Myliobatis asperrimus*, Gilbert, C. H., in Jordan, D. S., & Evermann, B. W., *Fishes North and Middle America*, 3, 1898: 2754 (original description, dimensions; type locality, Panama; Type, No. 11,895, Stanford University). Gilbert, C. H., & Starks, E. C., *Fishes of Panama Bay*, 1904: 19, Plate 3, fig. 6 (description, measurements; figure, Panama. This is a copy of the original description with punctuation and arrangement somewhat altered). Garman, S., *Bull. Mus. Comp. Zool.*, 46, 1906: 229 (Panama).

Pteromylaeus asperrimus, Garman, S., *The Plagiostomia*, 1913: 438 (description, color; Panama). Meek, S. E., & Hildebrand, S. F., *Marine Fishes of Panama*, 1, 1923: 92 (Panama; description, color; no specimens).

Stoasodon Cantor, 1849.*Stoasodon narinari* (Euphrasen).

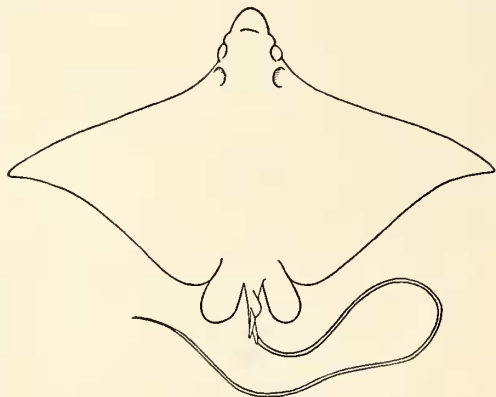
Range: Tropical Atlantic and Pacific. In the eastern tropical Pacific known from Mexico (Gulf of California, "west coast," Mazatlan), Costa Rica (Golfito, Gulf of Dulce), Panama (Panama Bay), and the Galápagos Islands (Hood and Seymour).

Field Characters: A large flattened ray with pointed wings; tail long, whip-like, without a caudal fin; a spine (occasionally two) at the base of the tail. Teeth in a single row, forming a long flattened plate, placed lengthwise in the lower jaw, crosswise in the upper. Brown to gray to

black above, the entire body and head covered with many round, sometimes elliptical, white or yellowish spots; ventral side white, bordered sometimes with darker toward the tips. (Illustration after Jordan & Evermann, 1900.)

Color: (730 mm.-wide specimen from South Seymour Island, Galápagos Islands). Black above, covered with numerous grayish white spots narrowly bordered with pale grayish-blue, which average 8 mm. in diameter and are about 12 to 15 mm. apart. Cephalic fins black; forehead and suborbital area mottled gray and white. Under parts white except for a narrow grayish-black irregular border to the cephalic lobe, and the outer half of each pectoral fin which is irregularly mottled and marbled with grayish-black. This pattern extends faintly and narrowly along the anterior edge almost to the head and more broadly towards the rear edge of the fin towards the vent. Each pectoral is broadly edged with black along the distal half of the anterior and all of the posterior edge. Proximal part of the tail as far as the spines with oblique gray lines alternating with white. Dusky mottling between the gill slits. Iris brownish-black, shading to grayish-white around the pupil.

Size: Grows to 12 feet long, 7.5 feet across the disk, and an estimated weight of 450 pounds. An 11-pound ray measured 730 mm. across the disk.



Text-figure 36.

Study Material: 4 specimens. Galápagos Islands: Seymour Island, 1 (5231), 730 mm. across the disk, April 5, 1925, harpooned. Galápagos Islands: Hood Island, 3 (5,503, 5,504, 5,505), 490, 495, 520 mm. across the disk, April 26, 1925.

One ray about 12 to 15 inches across the disk was seen close to shore in shallows at Golfito, Gulf of Dulce, Costa Rica, March 7, 1938.

References: *Raia narinari*, Euphrasen, B. A., *Vedensk. Akad. Nya. Handl.*, 11, 1790: 217 (description, after Marcgrave).

Aetobatis narinari, Günther, A., *Cat. Fishes Brit. Mus.*, 8, 1870: 492 (synonymy in part; short description; Bay of Panama). Garman, S., *Bull. Mus. Comp. Zool.*, 46, 1906: 230 (Panama). Günther, A., *Trans. Zool. Soc. London*, 7, 1868: 491 (Panama Bay; brief comparison with Atlantic example).

Aetobatus narinari, Jordan, D. S., Fishes of Sinaloa 1895: 391 (Mexico: Mazatlan; comparison with description of *A. laticeps*, which is questioned as having come from the west coast of America; copy of original description of *laticeps*; mentions that species has been taken several times in the Gulf of California). Gilbert, C. H., & Starks, E. C., Fishes of Panama Bay, 1904: 18 (description; comments on Jordan's 1895 paper; size of spots variable, and length of tail unreliable). Garman, S., The Plagiostomia, 1913: 441, Plate 49, fig. 1-3; Plate 54, fig. 4; Plate 55, fig. 9; Plate 57, fig. 4; Plate 73, fig. 4 (synonymy, description, color, figures of teeth, pelvis, vertebrae, heart and skeleton). Breder, C. M., Jr., *Bull. Bingham Oceanogr. Coll.*, 2, (1), 1928: 13 (specimen from unknown locality on west coast of Central America and Mexico).

Stoasodon narinari, Jordan, D. S., & Gilbert, C. H., *Bull. U. S. Nat. Mus.*, 16, 1882: 879 ("... The species is abundant on the west coast of Mexico, from which region the typical specimen was most likely obtained"). Clark, H. W., *Proc. Cal. Acad. Sci.*, (4) 21 (29), 1936: 395 (Galápagos Islands; sight record only).

Stoasodon laticeps, Gilbert, C. H., *Bull. U. S. Fish Comm.*, 2, 1882 (1883): 105 (Mazatlan, Mexico).

Myliobatis narinari, Lay, G. T., & Bennet, E. T., Zoology of Captain Beechey's Voyage, London, 1839: 56 (Panama).

Aetobatus laticeps, Jordan, D. S., & Evermann, B. W., Fishes North and Middle America, 3, 1898: 2753 (synonymizes *laticeps* with *narinari*; description of specimens from Mazatlan, Mexico).

Pteromylaeus sp., Walford, L. A., Marine Game Fishes of the Pacific Coast, 1937: Plate 26, fig. c (figure).

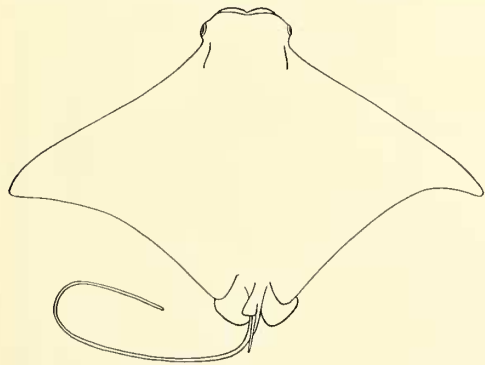
Discussion: All specimens seen by us were small and taken in March or April. However, the umbilical cord in these specimens has completely disappeared and there is no indication that these fish might recently have been born.

The specimen figured by Walford (1937) under the name of "*Pteromylaeus* sp." is considered a synonym of this species. Walford informs us that the specimen was not preserved.

Family RHINOPTERIDAE.

Rhinoptera (Kuhl) Cuvier, 1829.

Rhinoptera steindachneri Evermann & Jenkins.



Text-figure 37.

Range: Mexico (Gulf of California from Rio Colorado, and Guaymas, and an unknown locality along the coast of Mexico), Galápagos Islands (Chatham Island).

Field Characters: Medium sized rays with pointed wings and whip-like tail with serrated spine at the base; snout bilobed; upper surfaces dark gray, brown or black, lower surfaces creamy white, under the tips of the wings blackish.

(Illustration after Kumada & Hiyama, 1937, 646 mm. across disk.)

Size: Grows to a width of 710 mm. across the disk.

Study Material: None.

References: *Rhinoptera steindachneri*, Evermann, B. W., & Jenkins, O. P., *Proc. U. S. Nat. Mus.*, 14, 1891 (1892): 130, Plate 1, fig. 1 (description, measurement of two specimens, color, figure, figure of teeth; type locality, Guaymas, Mexico; type No. 43,235, U. S. National Museum). Jordan, D. S., & Evermann, B. W., Fishes North and Middle America, 1, 1896: 91 (copied description, common name). Jordan, D. S., & Evermann, B. W., Fishes North and Middle America, 4, 1900: figs. 38 and 38a (copied figure of animal and teeth). Garman, S., The Plagiostomia, 1913: 446 (description). Breder, C. M., Jr., *Bull. Bingham Oceanogr. Coll.*, 2 (1), 1928: 13 (2 specimens from between San Felipe and Shoal Point, Rio Colorado, in trawl at 10-14 fathoms). Kumada, T., & Hiyama, Y., Marine Fishes of the Pacific Coast of Mexico, 1937: 24, plate 58 (brief notice; figure of upper and figure of part of lower surface). Fowler, H. W., *Acad. Nat. Sci. Phila.*, *Monograph* 2, 1938: 19 (description, color, specimen from Chatham Island, Galápagos Islands).

Family MOBULIDAE.

Key to tropical eastern Pacific genera.

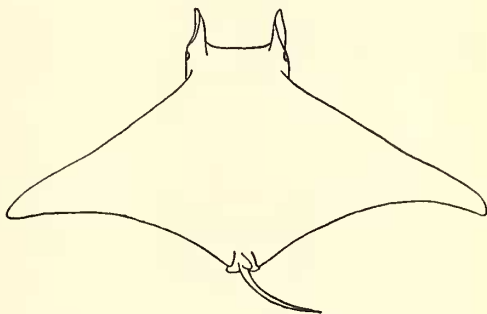
1a. Mouth inferior; teeth in both jaws. . . *Mobula*.

1b. Mouth terminal; teeth in lower jaw only. . . *Manta*.

Mobula Rafinesque, 1810.

Mobula lucasana Beebe & Tee-Van.

(Plate IV, Fig. 1).



Text-figure 38.

Range: San Lucas Bay, Lower California, with uncertain records from the coast of Costa Rica, and the Gulf of California.

Field Characters: Rays with pointed wing-like pectoral fins, and with two fleshy appendages on the head; mouth on under surface of head; teeth in both jaws; black above, whitish beneath. (Illustration after Beebe & Tee-Van, 1938, 1,035 mm. across disk.)

Description: The following is a copy of the original description:

"Skin smooth, no trace of rugosities or spines anywhere. Width across disk, 1,035 mm.; length from anterior margin of disk to posterior margin of the pelvic fin 584 mm. (anterior margin of the disk considered as being at the mid-line of the body, thus not including the cephalic

projections); cephalic fins extending forward 80 mm., beyond the anterior margin of the disk, the distance between their tips approximately 150 mm., distance from upper margin of the cephalic fin to lower margin of the fin when the fin is unfurled, 58 mm. Eye lateral, 17 mm. in diameter, its anterior margin 88 mm. from the tip of the cephalic fin. Spiracle oblique, 31 mm. posterior to the eye. Mouth inferior, 128 mm. wide, very slightly concave when viewed from below, the margin of the upper lip 40 mm. from the anterior margin of the disk.

"Teeth in each jaw in a narrow band, each band extending 70 percent of the width of the mouth. Upper jaw with 80 transverse rows of teeth and 5 rows from back to front. Lower jaw with 97 teeth in a transverse series and with 4 or 5 rows from back to front. Teeth small, flattened, their surfaces slightly roughened, the posterior border with 2 to 5 dull, irregular points. A typical tooth in the center of the lower jaw measures 1.2 mm. in width and .5 to .6 mm. in depth.

"Mouth to transverse line of first gill-openings 70 mm.; transverse distance between first gill-openings 133 mm.; transverse distance between last gill-openings 60 mm.; length of gill-slits of first four pairs of gill-openings 52 mm.; length of last gill-slit 37 mm.

"Pelvic fins rather elongate, their tips extending 31 mm. beyond the posterior tip of the pectoral, the inner margin extending backward farther than the outer, the fin nearly uniform in width, averaging 38 mm.

"Dorsal fin with its posterior one-fourth situated above the free portion of the tail, the base of the fin 57 mm., the height 46 mm.

"Tail immediately beyond the dorsal fin flattened, the skin of its upper surface reticulated, the reticulations being in the form of minute low, raised ridges of skin, the upper margins of which are roughened and occasionally slightly ciliate. Although the area mentioned above has this peculiar specialized skin there is no trace of a spine or of the beginnings of a spine. Tail beyond the expanded portion becoming attenuated near the tips of the pelvic fins, its diameter 50 mm. posterior to the tips of the pelvic fins being 3.5 to 4 mm.

"Color: In life upper surfaces, including the area about the eye and the upper part of the cephalic fins, blackish-gray; lower surfaces whitish becoming bluish-gray toward the tips of the wings, this color darkest on the anterior portion of the fins. Leading edge of undersurfaces of pectoral fin dusky, the posterior edges similarly colored but the band of color narrower. An oval, dusky spot near the posterior margin of the lower side of the pectoral fin, slightly nearer the pelvic fins than the tip of the pectoral. Tip of the cephalic fin black.

"The preserved type has the underside of the body, anterior to the mouth, and a narrow band along the lower jaw as well as the entire inner surface of the cephalic fin, brownish-black."

General Habits: These fish were common at San Lucas Bay and about Cape San Lucas. A number of individuals were seen somersaulting in the air and striking the water in descent with a sound audible for considerable distances. Others, presumably this species, were seen in Santa Inez Bay, Gulf of California, and off the west coast of Costa Rica.

Study Material: 1 specimen. Mexico: Cape San Lucas, 1 (24,793) the type of the species, 1,035 mm. across the disk, Mar. 30, 1936.

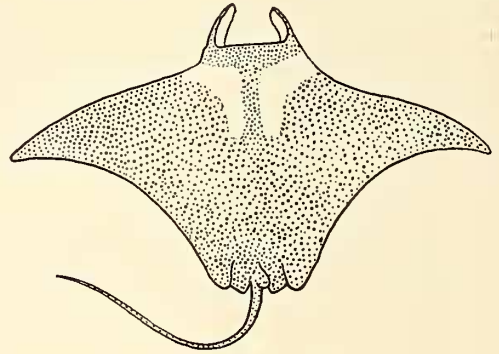
References: *Mobula* sp. Walford, L. A., Marine Game Fishes of the Pacific Coast, 1937: Plate 26, fig. d. (figure of upper surfaces).

Mobula lucasana, Beebe, W., & Tee-Van, J., *Zoologica*, 23 (15), 1938: 229-301, Plate 1, figs. 1, 2, Plate 2, figs. 3, 4, Plate 3, fig. 5 (original description, color, comparison with other eastern Pacific forms, figures of entire animal, lower surface of head, cephalic fins, posterior portion of body with dorsal fin, teeth. Type No. 24,793, Department of Tropical Research, New York Zoological Society; type in the collection of the American Museum of Natural History).

Manta hamiltoni (Newman).

Manta, Sea-Devil, Manta-ray.

(Plate IV, Fig. 2).



Text-figure 39.

Range: Warm waters of the eastern Pacific. Recorded from the Marquesas Islands, and along the American coast from the following localities; California: Redondo, San Pedro, San Diego; Mexico: Gulf of California, Guaymas, Mazatlan, Gorda Banks, Banderas Bay, Guatulco; Panama: Bahía Honda, Panama Bay, Pearl Islands; Peru: Zoritos, Tumbes; Clarion Island; Cocos Island; Galápagos Islands: Tower, Albemarle, Narborough.

Field Characters: Giant rays with pointed wings and large horn-like cephalic flaps; a long whip-like tail; mouth at front of body, not below; teeth present in the lower jaw only. Color, black above with large white symmetrical patch on each shoulder, the white at times almost invisible; white and black and gray below, the outer edges of the wings dark. (Illustration from specimen 6652, 18 feet across disk.)

Dimensions: Comparative measurements made in the field of mother and embryo are as follows (specimen 6652, Narborough Island, Galápagos, June 11, 1928):

	Adult	Young	Percent- age of Adult
Total spread	4572 mm.	1140 mm.	25
Lower jaw to anus	1800	440	24.5
Lower jaw to tip of broken tail	2800	—	—
Breadth along posterior wing	3050	540	17.7
Length anterior gill slit	625	115	18.3
Length posterior gill slit	390	80	20.5
Antero-posterior gill area	450	120	26.6
Distance between right and left posterior gills	310	70	22.5
Distance between right and left anterior gills	605	125	20.6
Cephalic Appendages:			
Length, posterior edge	720	145	20
Greatest width	274	60	21.7
Width base	350	63	18
Width mouth	870	170	19.5
Base cephalic appendage to 1st gill slit	380	70	18.5
Length ventral fin, outer border	520	95	18.2
Width head, eye to eye	1400	305	21.8
Eye diameter, eye ball	84	12	14.2
Iris	38	5	13.2
Base of dorsal fin	200	70	35
Height of dorsal fin	230	55	23.9
Front of head to dorsal fin	1830	450	24.5
Total length of tail	880	540	—
	(broken)		
Weight	2310 lbs.	28	12.1

Measurements as to the teeth and the extent of the teeth band in the embryo are as follows: The width of the mouth in the preserved specimen is 157 mm., and the tooth band extends across 75% of this width or 116 mm. At the rear of the tooth band there were 96 rows of teeth in a transverse series.

Color: The eighteen-foot-wide female taken at the Galápagos Islands was colored as follows: Above black (but see under *Discussion*), below dark bluish with the exception of a large white triangle on the anterior proximal portion of the wing; in other words, there is a wide dark outer border to the wing. Posterior edge of all gill slits white. Cephalic fin jet black above with a broad center of pale turquoise blue clouding.

Embryo, 28 inches across the disk: Above jet black with faint grayish white shading back and in from the nostril nearly to mid-line of back and then back in a foot-shaped mark with the sole lying not far from the mid-line and the toes just above the beginning of the body cavity (field description of white shoulder patch). Below pinkish-white with symmetrical bluish-black patches as follows: entire eye protuberance, a spot below and one-third toward center of mouth, a large irregular rounded patch back from the outer half of the posterior gill-slits, and a large cloud-like patch V-ing up from the anus and out toward the posterior gill slits. Distal half of the wings darker than the anterior proximal portion.

There appears to be considerable variation of the color of the under surface, but this general pattern was repeated on a cut-up specimen seen

in a fisherman's boat at Panama, that had the underside of the single remaining pectoral fin half black. We also noted that markings on these animals fade considerably with drying. The anterior edge of the tips of the wings is white.

Size and Weight: Grows to 18 feet 6 inches across the disk. Our 18-foot specimen weighed 2,310 pounds and the 1,140 mm.-wide (45 inches) embryo weighed 28 pounds.

Breeding: On the date of capture, June 11, 1925, the embryo had its tail protruding from the female, and the yolk sac was almost completely absorbed; hence it would probably have been born in a day or two. The yolk sac remained as a knotted string, six inches long.

Pellegrin (1901) noted that the species mated in May in the Gulf of California.

General Habits: Remoras are particularly abundant commensals of the mantas. Typical of our notes in regard to this matter are those relating to mantas and remoras seen at the Pearl Islands and recorded as follows:

" . . . From each side of the front part of the wings two large *Echeneis* clung. Each was at least two and a half feet long, very thick and stout, and white beneath, which was of course the visible part above as they clung upside down. They never changed places and very often their widely gaping, scarlet gills were high out of water. Six or eight smaller suckers, some not more than three or four inches were slithering over the black and white back of the manta. The same day we saw several more mantas like this first."

References: A. References definitely referring to mantas with white shoulder patches.

Manta sp., Beebe, W., "Galapagos, World's End," 1924: 312,435 (Tower Island, Galápagos; color and pattern; approximately 10 feet wide).

Giant Ray, Gray, Z., "Tales of Fishing Virgin Seas," 1925: 60-61 (Indefatigable Island, Galápagos Islands, figure of white marked specimen 15 feet across), 71 (Galápagos Islands, leaping out of water), 73 (Galápagos Islands, leaping out of water to remove remoras), 81, 82 (swimming); plate xvii (photograph of white marked specimen).

Manta birostris, Walford, L. A., *Calif. Fish and Game*, 17 (4) 1931: 404, fig. 112 (San Pedro, California; photograph of female specimen lying on dock, fourteen feet across).

Manta pinchoti, Whitley, G. P., *Australian Zoologist*, 8 (3) 1936: 182, based on *Manta birostris* of Fowler, H. W. (*Proc. U. S. Nat. Mus.*, 80 (6), 1936: 2), (Not *Manta birostris* Walbaum), part referring to the Marquesas "Sea Bat" described and figured by Pinchot, "To the South Seas," 1930: 405 et seq., 415, 411, 412, 417, 419.

B. References indefinite as to color.

Ceratoptera, Streets, T. H., *Bull. U. S. Nat. Mus.*, 7, 1877: 54 (Gulf of California).

Brachioptilon hamiltoni, Newman, E., *Zoologist*, 7, 1849: 2357 (species named on basis of letter noting capture of strange fish in the Gulf of California; capture by harpooning; weights, notes).

Manta hamiltoni, Beebe, W., "The *Arcturus* Adventure," New York and London, 1926: 123, 134, 135, 206, 304, 415, 434, figs. 30, 35 (Galápagos Islands, capture, figure; this record refers to a white-shouldered manta, although there is no mention of such color).

Cephaloptera birostris, Oustalet, E., *La Nature*, 25, 1899: 273-274 (Mexico: Guaymas; figure, general account, remoras).

Ceratoptera birostris, Pellegrin, J., *Bull. Mus. Nat. Hist. Paris*, 7, 1901: 161, 167 (Gulf of California; size and measurements, copulation in May; "La femelle est ovovipare").

Manta birostris, Jordan, D. S., & Gilbert, C. H., *Bull. U. S. Fish Comm.*, 2, 1882 (1883): 105 (Mexico: Mazatlan). Jordan, D. S., *Fishes of Sinaloa*, 1895: 394 (Mexico: Mazatlan; "Said to be frequently seen in the open sea

about Mazatlan; not seen by us"). Snodgrass, R. E., & Heller, E., *Proc. Wash. Acad. Sci.*, 6, 1905: 346 ("We frequently saw, amongst the islands of the Galapagos archipelago, enormous rays probably belonging to this species, but no specimens were obtained"). Vaillant, L. L., & Diguët, L., *Bull. Mus. Paris*, 4, 1898: 127-129 (Gulf of California; notes on habits, capture). Baer, G. A., *Bull. Mus. Hist. Nat. Paris*, 5, 1899: 111-112 (Peru; Zorrillo: notes). Vaillant, L. L., *Bull. Mus. Hist. Nat. Paris*, 5, 1899: 112, 113 (notes). Smith, H. M., *The Fishes of North Carolina, North. Car. Geol. and Econ. Survey*, 2, 1907: 48 (Gulf of California; use of cephalic appendages). Fowler, H. W., *Proc. U. S. Nat. Mus.*, 80, 1932: 12 (remoras taken from manta at Tower Island, Galápagos), 13 (same). Herre, A. W., *Field Mus. Nat. Hist., Zool. Ser.*, 21, 1936: 25 (Cocos Island, Galápagos Islands; habits; leaping out of water; swimming near surface with upturned wings). Fowler, H. W., *Acad. Nat. Sci. Phila., Monograph* 2, 1938: 249 (Galápagos Islands localities: Albemarle, Narborough, Tower; Cocos Island). Schmitt, W. L., *Annotated List of Fishes, Presidential Cruise, 1938*: 5 (Cocos Island; 1645 pounds, 15 feet wide and 9 feet long, exclusive of a 4 foot tail). Schmitt, W. L., *Explorations and Field Work of the Smithsonian Institution in 1938*: 12 (Same record as reference immediately above). Manter, H. W., *Allan Hancock Pacific Expeditions*, 2 (14), 1940: 440 (Panama: Bahía Honda; trematodes).

"Ray," Pinchot, G., "To the South Seas," 1930: 148-158 (Tower Island, Galápagos; photographs, capture, color; data sent to U. S. National Museum).

Study Materials: 2 specimens, Narborough Island, Galápagos Islands, 2 (6652, 6653) adult female and male embryo, 5,486 mm. (18 feet) across disk and 1,140 mm. respectively, June 11, 1925 (*Arcturus* Oceanographic Expedition). Besides these specimens this fish has been seen by us at the following localities: Gulf of California between Guaymas and Santa Inez Island (one seen), up to 16 feet in width; Clarion Island, (four seen); Mexico: Banderas Bay (one seen); Gorda Banks (one seen) and Guatulco (several seen up to 16 feet in width); Panama: Pearl Islands, one seen at close range and photographed, several others seen.

Discussion: While endeavouring to thrash out the relationships of the Pacific coast manta and the Atlantic *Manta birostris*, the following notes were made. Many of the questions that arise as to these animals cannot fully be answered without further studies and especially those made in the field with fresh material, but we may mention that the evidence indicates separation of Pacific *hamiltoni* with immaculate white shoulder patches from Atlantic *birostris* with black spots in white shoulder patches.

Newman, in 1849, described *Brachioptilon hamiltoni* from the Gulf of California, this being the first account of a manta from the eastern Pacific. Newman's name was based upon a letter from Commander Cospatriek Baillie Hamilton of H. M. S. *Frolic*, in which Commander Hamilton described the capture in the Gulf of California of what was obviously a manta.⁹ The description given in this letter and in Newman's notes on an unpublished drawing of the fish mentions only the size of the animal and the fact that it possessed "a sort of arm projecting from the shoulder." The size of the

fish, 19 feet in width, is the only factor that indicates that the fish was of the genus *Manta* and not *Mobula*. There are no records of an eastern Pacific *Mobula* growing as large as 19 feet across the disk.

Most authors since Newman have placed *hamiltoni* in the synonymy of *birostris*, thus considering the mantas of the Atlantic and Pacific as one and the same species. As mantas are difficult to compare because of size and the problems of preserving them, and as relatively few have been studied alive by ichthyologists, such a conclusion was more or less inevitable.

In 1924 Beebe published a note about a manta seen at Tower Island, Galápagos, that had large conspicuous white patches on the shoulders and in 1932 he noted others at the Pearl Islands, Panama Bay. Zane Grey in 1925 recorded similarly marked specimens at the Galápagos Islands, and Walford in 1931 gave an illustration under the name of *Manta birostris*, of a white-shouldered manta taken at San Pedro, California. During the Eastern Pacific *Zaca* Expedition several white-shouldered mantas up to 16 feet in width were observed at Port Guatulco, Mexico, on Dec. 3, 1937. Recently white-shouldered mantas were the subject of motion pictures taken on the coast of Peru by the Michael Lerner Expedition. These six accounts represent all of the definite records in the eastern Pacific of white-shouldered mantas.

Pinchot in 1930 published excellent illustrations of a white-shouldered manta that he had taken at the Marquesas and in 1936 this fish was named *Manta pinchoti* by Whitley. A comparison of the various descriptions and illustrations mentioned above leaves no doubt in our mind that the eastern Pacific and the Marquesas mantas belong to the same species.

In attempting to clarify the status of the white-shouldered mantas, certain questions arise:

1. Is the white-shouldered color pattern confined to one sex?

This question can be answered in the negative, as our 18-foot-wide, 2,310-pound female with white shoulder patches, carried a male embryo weighing 28 pounds that also had the same markings.

2. Do all of the eastern Pacific mantas have white shoulders?

An unqualified answer to this question must await further observations, but from the available evidence the answer would seem to be "Yes." This conclusion is based primarily upon the supposition that the white shoulder-patches may be masked (as is suggested later on) so that they are not visible, and, secondly, that even when they have been observed little attention was paid to them and to their significance. We also believe that the same conditions hold true for the Atlantic manta, which as is shown later on in these pages, also possesses white shoulder-patches.

In support of this conclusion our own experience with mantas, and especially with a manta

⁹ In Commander Hamilton's letter there is the following account of the lifting aboard ship of this fish: ". . . I could not ascertain the weight; but some idea may be formed by the fact that sixty men were unable to lift him on board with the yard tackles: the heaviest purchases in the ship, with one hundred and fifty men were required for the purpose. . . ." Evidently the lifting of a ton to a ton and a half was a formidable enterprise on a man-of-war in 1846.

captured by us in 1925 on the *Arcturus* Oceanographic Expedition, is especially pertinent. Some of our field notes relating to these fishes, which were exceedingly common off the west coast of Albemarle Island and the north Coast of Narborough Island in the Galápagos group, are as follows:

"Station 84, 1 mile north of Narborough Island, June 9, 1925. DEVIL FISH. Common both near shore and three miles out, keeping much on the surface. The back comes up and might be a seal except for its great width. It then submerges and the tips of the wings appear, sticking straight up, black on the inner side and white on the outer side. When by chance only one wing protrudes it resembles a shark's fin, and when further out it looks like the dorsal fin of a blackfish.

"They are not very wary and for an hour we played with one in two boats, bumping into it continually and being splashed by the thrashing wing-tips as it turned. There were two, about ten feet spread, one of which had lost a piece of the tip of the left wing. They refused to go down and were swimming along when we left them.

"The boys had no trouble in harpooning a large one but it swam off with two harpoons and two kegs. The second one put up only a comparatively feeble fight and they were able to head it to the steamer. It was 18 feet tip to tip and weighed somewhere about 2300 pounds. A young one was about to be born, weighing 28 pounds."

Motion pictures were made of the capture of this female manta and of its being hoisted aboard the *Arcturus*, and many notes were recorded about this fish and its embryo, but *nowhere* is there a mention of the adult manta possessing white shoulder-patches, although the field notes contain data to the effect that the embryo after extraction from its mother did have indications of white shoulder-patches.

To check on whether the adult did or did not have white shoulder marks, the motion picture negative of the capture of the fish was looked over. Practically all of the film shows the underside of the fish, but, fortunately, a small section shows part of the upper surfaces and is reproduced here as Plate 4, Fig. 2. This photograph definitely shows, although vaguely, the presence of white shoulder patterns and we thus have definite proof that both male and female Pacific mantas possess these white patches.

At least three ichthyologists saw this manta at the time of capture and the fact that no especial comment was made as to the white on the upper surfaces seems to be of significance; evidently the white marks are not always sufficiently prominent as to cause comment, and they may not always be visible.

In this connection it may be remarked that the preserved 28-pound embryo now shows no trace of the white shoulders that were evident when it was removed from its mother.

There is a possibility that the solution to the

masking of the white patches on the dorsal surface of the mantas, may be laid to pigment carried in the outer skin which becomes free and at times overlays the white patches. Coles,¹⁰ writing of the Atlantic manta, has the following note: ". . . The color of the back of *Manta* is dead black, although specimens are frequently observed with dirty white patches showing on the dorsal surface. This change of color is due to the scraping off of the superficial coloring layer when the fish has been swimming at the surface for some time; the black color is restored when the *Manta* has remained beneath the surface for some time. While washing off the surface of a *Manta*, both the cloth and the water used became colored black by pigment, and the whole dorsal surface became lighter in color. I have also placed a handkerchief upon the skin of a dying *Manta* and observed that it was heavily coated with black coloring matter discharged from the skin."

Pinchot¹¹ gives similar evidence as he states that the dorsal color of a Tower Island, Galápagos manta was "very dark gray or black carried in a thin slimy outer skin that came off easily in the hands."

3. Is the manta of the tropical eastern Pacific, *Manta hamiltoni*, distinct from the Atlantic manta, *Manta birostris*?

We have not been able to gather sufficient evidence uncomplicated by differences in age, etc., to answer the question as far as morphology is concerned. From the standpoint of color, however, the following notes were made.

The literature of the Atlantic manta, *M. birostris*, with the exception of two references that are discussed below, consistently list the color of the upper surfaces as being black, with no mention of a symmetrical white pattern on the shoulders. There are occasional statements of white patches, unsymmetrical in form and placing, that apparently are caused by abrasions.

The exceptions to the almost unanimous recording of a uniformly colored dorsal surface in *birostris*, are as follows. In C. F. Holder's volume "Big Game at Sea" (Outing Publishing Co., New York, 1904) on the plate facing page 24, there are four photographs of a large manta, and in two of these, prominent, white symmetrical shoulder-patches are present. The plate contains no data as to where the manta was taken, but on page 35 there is the following statement referring to St. Petersburg, Florida, which would be presumed to relate to the photographs: ". . . Dozens of kodaks and cameras were in evidence, and the devil-fish was the most photographed curiosity the city has seen for many a day."

As this record was not as definitely labelled as it might have been, and as most of Holder's volume referred to Pacific fishes, the possibility that a photograph of a Pacific manta with white

¹⁰ Coles, R. J., *Bull. Amer. Mus. Nat. Hist.*, 35, 1916: 653, 654.

¹¹ Pinchot, G., "To the South Seas," 155.

shoulder-patches had been substituted as an illustration for a Florida specimen, was considered. As the mantas of the Atlantic and Pacific had been recorded as the same species, such a substitution would not have been too far-fetched.

Many of the chapters in Holder's volume were first published in magazines, and a search was therefore started through old files in an endeavour to substantiate or disprove the verity of the photographs. Surprisingly enough, the fact that the photographs were taken in Florida was validated by completely independent evidence. In "Outing" Magazine, volume 39, 1902, on page 560, in an article written by R. B. Seager entitled "Tarpon and Sharks on the east coast of Florida," there is an excellent photograph of a manta taken at Punta Rassa, on the west coast of Florida, which shows very prominent, symmetrical, white shoulder-patches. These patches agree perfectly with those shown on the Holder specimen in having a series of small black spots down the center of the white; there is no indication of these internal dark spots in any of the illustrations of Pacific mantas.

In our own files, we have a drawing of a manta that was seen on June 11, 1930, off Bermuda, under the bow of the vessel while we were making one of the bathysphere dives. This manta, estimated to be about twelve feet across the disk, had white shoulder-patches and a white chevron-like mark on the posterior part of the disk near the tail. The shoulder-patches in the drawing are elongate, somewhat crescentic spots, with no sign of black inner spots, situated in the correct position but wider apart and somewhat differently shaped than those of the Florida specimens mentioned above. The accuracy of the shape and the presence or absence of black spots, can of course be questioned, as this plate was based upon a sight record of short duration.

We thus have proof that both Atlantic and Pacific mantas do have white shoulder-patches.

Also, based on the same evidence, the Atlantic and the Pacific mantas can be differentiated by the presence of dark spots within the white patches in the Atlantic fish and by the absence of the dark spots in the Pacific manta.

4. Is there a white-shouldered and a non-white-shouldered species in each ocean?

We believe that the answer to this question is "No," and suggest that future investigators of live material check on the possibility that the white patches are masked by black free pigment.

Summarizing the above notes, the following observations can be made:

a. *Manta pinchoti* Whitley may be synonymized under *Manta hamiltoni*, as the Marquesas form shows no differences from the coastal eastern Pacific form, for which the name *hamiltoni* is available.

b. The white-shouldered pattern is found in both sexes of Pacific mantas.

c. Both Atlantic and Pacific mantas possess white shoulder-patches, the intensity of coloration being variable, and the white patches are possibly masked by the presence of loosely attached black pigment.

d. The Atlantic mantas with white shoulder-patches have black spots in the patches, while the tropical eastern Pacific form has immaculate shoulder markings.

e. No evidence is adduced as to the possibility of there being a white-shouldered and a non-white-shouldered species in the Atlantic and in the tropical eastern Pacific. It is believed that only one form is present in each of these regions.

Subclass HOLOCEPHALI.

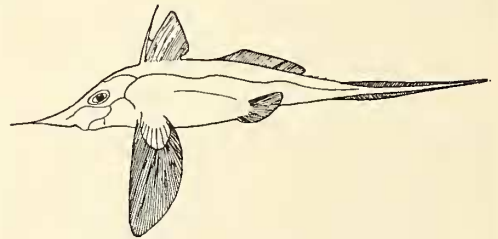
Key to families of the tropical eastern Pacific.

- 1a. Snout produced into a long simple beak.
Rhinochimaeridae, p. 278.
- 1b. Snout produced into a leaf-shaped flexible appendage.....*Callorhynchidae*, p. 279.

Family RHINOCHEMAERIDAE.

Harriotta Goode & Bean, 1895.

Harriotta curtiss-jamesi Townsend & Nichols.



Text-figure 40.

Range: Known only from a single locality off the west coast of Lower California (90 miles N. W. of Cape San Lazaro) in 645 fathoms.

Field Characters: Small fishes with long, simple, beak-like snout and an elongate tapering filamentous tail; first dorsal fin rather high and preceded by a spine; pectoral fins large and wing-like; color black. (Illustration after Townsend & Nichols, 1925, 152 mm.)

Size: The only known specimen is six inches long.

Abundance: Rare, one specimen known.

References: *Harriotta curtiss-jamesi*, Townsend, C. H. & Nichols, J. T., *Bull. Amer. Mus. Nat. Hist.*, 52, 1925: 6, fig. 2 (original description, color, figure; type No. 8342, Amer. Mus. Nat. Hist., type-locality, Albatross station 5685, 25° 42' 45" N., 113° 38' 30" W., 90 miles N. W. of Cape San Lazaro, Lower California, 60 miles off the nearest land, in 645 fathoms).

Family CALLORHYNCHIDAE.

Callorhynchus Lacepede, 1798.*Callorhynchus callorhynchus* (Linnaeus).

Range: Southern Brazil, Argentina, Chile and Peru (Peru: La Ventanilla, Callao).

Field Characters: Fishes with a flexible proboscis ending in a leaf-like terminal portion; first dorsal fin rather high and preceded by a spine; color silvery with age, varying dark or pale; young with black spots.

Size: Grows to over 800 mm.

Study Material: None.

References: *Chimaera callorhynchus*, Linnaeus, Syst. Nat., ed. 10, vol. 1, 1758: 236 (type locality "In Mari Aethiopici").

Callorhynchus callorhynchus, Starks, Proc. U. S. Nat. Mus., 30, 1906: 764 (description, color, Callao, Peru). Evermann and Radcliffe, U. S. Nat. Mus., Bull. 95, 1917: 18 (synonymy, dimensions, description, color; La Ventanilla, Peru). Norman, Discovery Reports, 16, 1937: 35-36 (description; synonymizes *smythii* under *callorhynchus*).

Callorhynchus smythii, Lay and Bennett, Zoology Beechey's Voyage, Fishes, 1839: 75, Plate 22, fig. 3 (original description based upon a drawing by Smyth; La Concepcion, Chile).

Callorhynchus smythii, Garman, Mem. Mus. Comp. Zool., 40, 1911: 98.

Callorhynchus tritoris, Garman, Bull. Mus. Comp. Zool., 41, 1904: 257, 271, Plate 6, fig. 9 (type-locality: Mexillones, Peru?).

Callorhynchus smythii, Fowler, U. S. Nat. Mus. Bull., 100, Vol. 13, 1941: 508-509 (description, color, synonymy).

Discussion: Three forms of *Callorhynchus* have been reported from Peru: *callorhynchus*, *smythii*, and *tritoris*. The recent taxonomic history of the west coast Pacific form is as follows: Fowler (Bull. 100, U. S. Nat. Mus., Vol. 13, 1940: 509-510) synonymized *tritoris* under *smythii*; Norman, Discovery Reports, 16, 1937: 35-36) synonymized *smythii* under *callorhynchus*; and Fowler, in "Los Peces de Peru" (Bol. Mus. Hist. Nat. "Javier Prado," Ano 5, No. 17, 1941) lists only *Callorhynchus callorhynchus*.

Mexillones, Peru, the type locality of *tritoris*, as stated by Garman, may refer to Mexillones or Mejillones, Chile, in which case the supposed Peruvian record of the nominal *tritoris* does not come under the geographical limits of this publication. The U. S. Navy Hydrographic Office publications (Pilots and charts) give no mention of Mexillones or Mejillones in Peru.

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EXPLANATION OF THE PLATES.

PLATE I.

- Fig. 1. *Narcine vermiculatus*. Specimen from off La Libertad, El Salvador, 13 fathoms, 58 mm.
- Fig. 2. *Discopyge ommata*. Specimen from Santa Inez Bay, Lower California, 168 mm.

PLATE II.

- Fig. 1. *Dasyatis pacificus*. Upper surface of holotype, length 1,524 mm.
- Fig. 2. *Dasyatis pacificus*. Lower surface of holotype, length 1,524 mm.
- Fig. 3. *Dasyatis pacificus*. Dorsal tubercles, $\times 10$.
- Fig. 4. *Psammobatis spinosissimus*. Photograph of holotype, 248 mm.

PLATE III.

- Fig. 1. *Dasyatis brevis*. Specimen from Inez Bay, Lower California, 1,257 mm.
- Fig. 2. *Urobotis concentricus*. Specimen from Port Guatulco, Mexico, 385 mm.

PLATE IV.

- Fig. 1. *Manta lucasana*. Upper surface of holotype, 1,035 mm. across disk.
- Fig. 2. *Manta hamiltoni*. Enlargement of motion-picture film of 18-foot-wide female, taken at Narborough Island, Galápagos Islands, showing indistinctly the pale shoulder-patches.